children

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Thesis

A STUDY IN THE PITCH OF ORAL READING OF FOURTH GRADE CHILDREN

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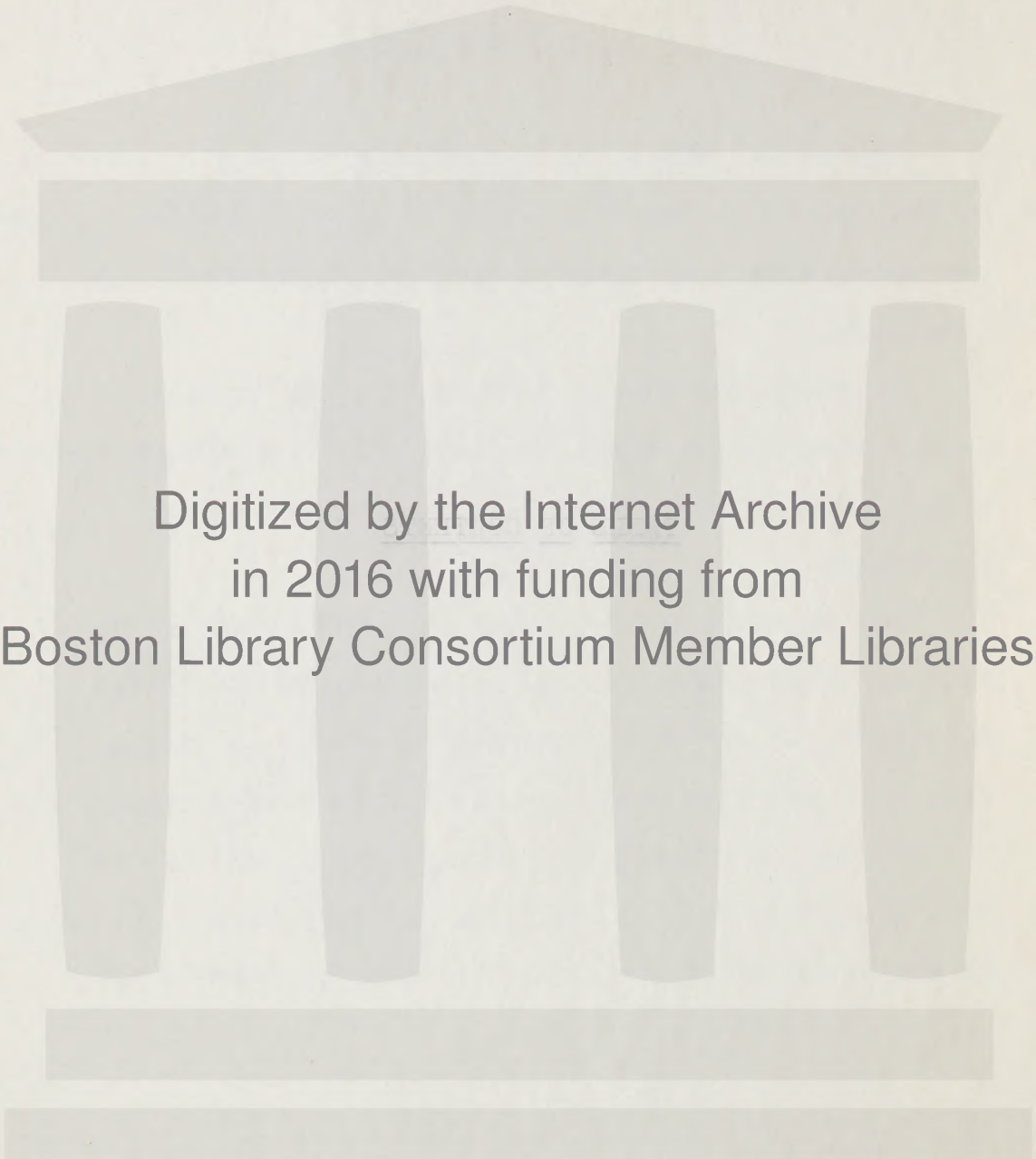

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INTRODUCTION

For much of the Information on German and French research I am greatly indebted to the work of Edward Scripture and Alfred Root. This obligation is acknowledged here and throughout.

Introduction

The purpose of this investigation is to study pitch differences of childrens' voices in conversation and in reading material of easy, average and difficult mastery. The related problems of this investigation are:

1. To attempt to determine the effect of difficult reading on the pitch of the voice.
2. To attempt to determine whether all oral reading utilizes a pitch level above that of conversation.
3. To attempt to determine whether high pitch of the voice is more directly a result of habit than of any apparent reading difficulty.
4. To attempt to determine how reliably the pitch of the speaking voice may be evaluated by competant judges.

The pitch of the speaking voice has for many thousands of years captured the interest - and in many instances, the imagination - of researchers and students to no small degree. Thus, in order to summarize the rather extensive work in this field, a rather arbitrary division of the research has been made in order to catalogue significant findings under uniform headings. Since these divisions are arbitrary, they cannot be followed in detail, but an attempt is here made to place a few previous investigations under one of the following three headings:

A. Observational, or speculative research

B. Experimental, or laboratory research

C. General, or significant research not properly in the above catagories.

A.

The earliest research that is still valid is that of Aristoxenux,[1] who in 350 B.C. differentiated between speech and song. The difference lies apparently not in the kind of vibration, but in the manner in which the tone of the voice runs up and down in pitch. Song, Aristoxenus characterized as a movement of pitch from one stationary point to another to another, white speech is a continuous pitch movement even within the vowels and consonants themselves. This point of view which strongly suggested the need of scientific verification; has waited two thousand years for further research, and only with the last two decades had this observation been confirmed.

300 years later, Dionysius of Halicarnassus[2] related music and speech by saying that they differed in degree, not in kind. The melody of spoken language was compassed by a single interval of the fifth. The pitch in the utterance of a single word was found constantly to change, and take the form of a rising, falling or circumfles movement. This viewpoint is interesting in that it reappears continuously in speech literature, and seems to be well substantiated by subsequent research.

[1] Aristoxenus, Harmonica Quoted from E.W.Scripture, Elements of Experimental Phonetics, pg. 268, which is quoted in turn from a thesis by Johnson, Musical Pitch and the Measurement of Intervals, Baltimore, 1896.

[2] Dionysius of Halicarnassus, W.R.Roberts, London, MacMillan 1910, quoted from Root, A.R. "The Pitch Factor in Speech" Quarterly Journal of Speech XVI, 1930 No.3, p.320-341

Following the ideas of Dionysius, though misinterpreting his purposes, Joshua Steele [1] believed that the rises and falls of the voice pass through an interval of three and a half tones. Thus, believing that music and speech have common qualities, he attempted to reduce the inflection of speech to the intonation of music, with musical notes and notations for the benefit of the oratorical student who would follow his manual.

The folly of having our orators become singers as well was perpetuated by Rush [2], whose textbook on the Philosophy of the Human Voice became a major influence among the elocution teachers of the early 19th century. Rush also believed that the musical system of notation could be employed in speech, though somewhat differently. He felt it advisable to adopt musical notations to represent the function of the voice. Thus, representations of "concrete" sounds or slides, "discrete" sounds, scales, radicals and vanishing movements were all applied to speech. In addition, the attempt was made to interpret the various movements according to the meaning expresses.

Twenty years later, Alexander Melville Bell [3] followed the theory of Aristoxenus and Dionysius of Halicarnassus, that the voice moves by sweeps over all intervening intervals, hence

[1] Steele, Joshua Prosodia Rationalis, London, 1775

[2] Rush, J. The Philosophy of the Human Voice, The Library Company, Philadelphia, 1827

[3] Bell, A.M. The Principles of Speech, Edinburg, W.P.Kennedy, 1849

the very nice systems of notation adopted by both Rush and Steel were valueless. However, he did use in his work a staff with musical notes to show graphically the degrees of inflection. He fully realized that the staff, and the notes thereupon affixed did not truly represent speech inflections with precision, and the voice, while following to some extent the outlined patterns, might deviate by many tones or by semitones throughout.

This point of view, which is entirely correct, was substantiated by the work of Ellis,[1] who not only enlarged upon the idea of indefinateness and vagueness in the slides and glides of the voice without definately intended or perceived intervals and substained tones, but also commented upon the presence of registers in the voice. Thus, he felt, every voice possessed a relatively high, medium and low pitch, regardless of the prevailing tone of speech.

A few years later, in 1863, the opinion began to shift once again to the quasi-musical notion of speech, this with the writings of Merkel.[2] He stated that in the perception of spoken sounds, melodies were heard, although there is a lack of difiniteness in the beginnings of the intervals and the maintenance of a syllable on a note. This viewpoint has been rather thoroughly upheld by the German investigators,

[1] Ellis, K. quoted from Alfred R. Root, op. cit.

[2] Merkel, L. quoted from E.W.Scripture, "Studies of Melody in English Speech" Philosophische Studien 9 Band 1 Theil 1902, pg. 599

with Wundt[1], Scripture[2], and Storm[3] writing extensively on the melody in speech. Storm was of the first few to recognize the glide character of the speaking voice, and stated that the gliding of the voice through several notes made an impression of "unrefined, mixed, unmusical noise."[3] Speech was, however, somewhat musical in nature since there was an intervallic effect. He said, "Everybody sings more or less in his speech, that is, he remains more or less on the tones, or forms more or less melodic tonal movements. In the latter case, there is a gliding through of harmonic intervals in which the beginning and end of tonal movement is distinctly heard." Wundt[1] considered melody in speech little more than a threshold to music. Glide tones, he felt, ran from one recognizable pitch to another, thus forming definite intervals. To each pitch one can assign a definite note, but the syllable as a whole is perceived with the pitch of the vowel. He further believed that the difficulty in recognizing speech intervals is due primarily to an inaccurate concept on the part of the observer concerning the size of the interval. The recognition of intervals in speech increase as the intervals approach the known musical ones.

Scripture[2] was among the first to make extensive use of laboratory equipment in the analysis of sound and speech.

[1] Wundt, W. Quoted from E.W.Scripture, Elements of Experimental Phonetics, op. cit.

[2] Scripture, E.W. Researches in Experimental Phonetics The Carneigie Institution of Washington Publications, 1906

[3] Storm, J. Quoted from Alfred R. Root, whose account this follows closely. Root has been previously cited.

His discussions are treated later, but his viewpoint on pitch is here cited: "The pitch of short sounds is hard to catch by the ear, not only because each sound contains many tones that influence the total impression, but especially because the pitch is always changing. Even from a long sound the ear receives only a vague impression of pitch when it is a changing one. These difficulties render it impossible to obtain by the ear any reliable data concerning the melody of speech."[1] He further states that, "just what vocal sound is perceived by the ear depends largely upon the sensitiveness to differences and on the past sounds which are most familiar. The perception of a sound is greatly influenced by associative suggestions. Elements are unconsciously modified, supressed to created. Even hallucinations of weak tones supposed to be physically present can be readily produced in nearly all normal individual by appropiate suggestions from the surroundings."[2]

One of the last discussions of the empirical school is that offered by Saran,[3] who, in discussing speech melody, felt that it could be interpreted according to a theory of dominent syllablic crest which consist of strongly intoned vowels and voice consonants. These, the uniniatee hear as spots or more or less extension and brightness. Between these

[1] Scripture, E.W. Elements of Experimental Phonetics Scribners Sons Company, New York, 1902 pg. 473

[2] as above, pg. 115

[3] quoted from A. R. Root, op.cit.

dominent crests are found the pauses and voiceless sounds which are perceived as a dull, unsorted mass in the background.

The foregoing is a very brief outline of the observational type of research that is pertinent to the present investigation. With the growing impetus of the experimental work, (c. 1900) which followed closely the development of new apparatus that could successfully be adapted for phonetic work, the observational type of approach diminished considerably. The one important study of this type which has been published recently is discussed under Part C - general research. For the rest, it suffices that they claimed nothing original that has not been either proven or disproved by subsequent experimental research.

B.

Strictly speaking, experimental work begins with the vibrating device of Scott.[1] Scott was a proof-reader who chanced upon a description and drawing of the human ear in a text-book he was reviewing. He reasoned that an artificial ear could be built that would record graphically the vibrations of the speaking voice. In his phonautograph, as he named this device, a large receiving instrument carried at its end a thin membrane whose movement when agitated by vibration caused a tiny lever affixed the membrane to write upon a smoked paper fastened upon a revolving drum.

[1] Scott, Inscription automatique des sons de l'air au moyen d'une oreille artificielle, 1861; quoted from Scripture, Elements of Experimental Phonetics, op.cit.

Sebsequent improvements - which are not applicable to this investigation - were made by several researchers, notably Scripture, but the apparatus of Scott's remains unchanged in principle until 1914. Little was done directly with the pitch of the voice in general, for the experimentation was largely confined to obtaining fundamental frequencies of the vowel sounds, and to the process of transcribing speech curves which could be read easily. This is Scripture's greatest contribution to the field.

With the advent of the World War, Germany ceased to be the focal point of research in the area of speech skills. Almost immediately following the publications of C.E.Seashore [1] on a new device (the Tonoscope) by means of which pitch of the voice could be read easily and more accurately than before, the center of research shifted to the University of Iowa, where to-day it still remains.

Seashore's contribution, though utilizing the manometric flame invented as an improvement for Scott's phonautograph, is entirely original. Essentially, it is a revolving, perforated drum, inside of which burns a manometric flame. Speech vibrations cause the flame to flicker, and the darkened area of dots on the drum indicate the pitch of the sound.

The applications of this apparatus to a study of pitch problems in speech were not so immediate as might have been

[1] Seashore, E.C. "The Tonoscope" University of Iowa Studies in Psychology IV, 1914 p. 1 - 12

supposed. Dr. Seashore's principal interest in research is musical in nature,hence the studies under his direction which utilized the Tonoscope were largely concerned with musical pitch.

A representative study is that by Schoen,[1] who began the scientific observation of the vibrato by studying the pitch variations in the singing of five artists. For objective observations, the Tonoscope was used, but it was found that Tonoscope readings were difficult to read, and prone to progressive errors. Hence, the next eight years were devoted to the development of the phonophotographic apparatus which produes a graphic record of the sound waves on motion picture film, thus providing a permanent record and the opportunity for more careful analysis. The credit for this improvement in speech analysing machines is hard to place, but most will agree that it belongs jointly to Metfessel[2] and Simon.[3] Complete descriptions of the apparatus are given by both authors, but the main parts of a laboratory type phonophotogrpahic device are: (a) a large drum, about which standard motion picture film winds after (b) photographing the light reflected in

[1] Schoen, M. "The Pitch Factore in Artistic Singing" University of Iowa Studies in Psychology VIII, 1922 pg. 230

[2] Metfessel, M. "Technique for Objective Studies of Vocal Art" Psychological Monographs XXXVI, 1926 No. 1 p.1

[3] Simon, C. "The Variability of Consequtive Wave Length in Vocal and Instrumental Sounds" Psychological Monographs XXXVI, 1926 No. 1 p. 40

vibratory movement from two phonelescopes, the one a graphic representation of sound waves from an unknown pitch of the voice or another vibrating instrument, and the other from a known source of 100d.v. electrically driven tuning for, this referred to as a "time line" (Metfessel) A phonelescope is an optical lever. A vibrating diagpragm moves a tiny mirror which vibrates synchronously with the movement of a phonel-escope diaphragm. A light is reflected from the mirror of the phonelescope to a film.

Once again, the improved apparatus was devoted to the objective analysis of musical performance. Although that which is applicable to music is generally applicable to speech, little inference in these later studies was drawn from one to the other. It remained for C. Horton Talley /1 and Milton Cowan /2 to investigate speech with the aid of the newer type laboratory equipment. Talley used an oscillograph, and Cowan utilized the phonophotographic devices.

Horton took oscillograms of the voices of eight experienced actors under conditions aproximating conversational and audience speech. By "aproximating" is meant that the actors were asked to assume a conversational pitch and manner and say, "He has risen to the top of the professions." The same sentence was selected to be delivered as though speaking to an audience. The word "top" was chosen to be analysed by a harmonic analysis. He found, "In general, when a speaker

/1 Talley, E.H. "A Comparison of Conversational and Audience Speech" Archives of Speech II no. 1 July 1937

/2 Cowan, M. "Pitch and Intensity Characteristics of Stage Speech" Archives of Speech Vol. I No. 1 July 1936

changed from conversational to audience type of speech, three changes in the sound wave produced by the voice took place simultaneously, namely, heightened pitch, increased intensity and a shift of energy from the lower to the higher partials. It does not seem possible to evaluate the relative importance of the three factors, not to state whether one element causally influences the other two."

Cowan, as has been indicated previously, utilized the phonophotographic equipment of Metfessel and Simon. Extensive recordings and analysis of dramatic passages as interpreted by 14 actors and actresses were made. Measurements of average pitch, range of pitch, etc., are given, though they are not immediately applicable here. However, he did find that the average pitch level of a given individual in different selections have the same pitch range can vary as much as five semi-tones.

The above two investigations are the latest to be published from the Iowa laboratories. There is, at present, a study not yet published on the pitch changes of the speaking voice during emotional states, which will be released for publication during the academic year 1939-1940.

C.

Under this heading of General Research are included three studies which properly do not belong with either of the above divisions because of either the chronological factor or because of their significance for this present

investigation.

The work of Alfred R. Root [1] in his "Pitch Patterns and Tonal Movements in Speech" is, to some extent, similar in purpose to the present investigation. Root selected eleven phonograph records, from which 81 syllables of running speech were chosen as representative of an inclusive sampling of the most general pitch patters used in American speech. Thirteen judges scoring high on a battery of acuity and musical aptitude tests were chosen to match each syllable of speech to the pitch of a reed organ. These pitches were matched to the nearest note, and from these judgements correlations were obtained. In order to further investigate the problem, phonophotography was employed in the objective re-analysis of the 81 syllables, as well as an additional 700 from the same material to investigate the possibility of undiscovered pitch patterns. He concludes that "the method of perceptual analysis has a high degree of consistency, as statements of obervers, graphic representation and statistical treatment of results show." The average correlation among observers is .95 for dominently perceived pitch, .86 for inflectional range and for observers in repeated analysis of the same material, .94 to .95. To correlate his first judgements, he used as a standard the judgments of one observer who was known to have the highest scores on auditory and vacomotor tests, and whose opinions were therefore assumed to be the

[1] Root, A. R. "Pitch Patterns and Tonal Movements in Speech" Psychological Monographs XXXX, 1930 No. 1

most reliable. The correlation on re-identification of pitch was obtained by matching the two judgments. This study is highly significant in view of the fact that it indicates rather positively that the extensive and elaborate equipment which has been thought essential to measure pitch and pitch variations is not necessary if but an average pitch level is desired.

A further important study is that of Weaver's[1], who likewise performed a series of experiments in the perception of sounds. Weaver investigated, amoung other things, the relationship between accuracy in producing vocal pitch and the sense of pitch. The coefficient of correlation between sense of pitch and accuracy of production was found to be ± 0.808 for the women in the investigation, and ± 0.0881 for the men. The cause for this disparity is not clear.

A second significant finding is that the errors in pitch (musical) can be detected with twice the accuracy for women's voices than for men's. The truth of this rests upon the assumption that the ear recognizes a change in a given number of vibrations with different acuity for the different registers; e.g. a change of ten vibrations at 300 d.v. would seem only half as great as a change of the same number of vibrations at 150 d.v.

The above findings relate directly to the present experiment in which women observers were used to judge the pitch of children's speaking voices.

[1] Weaver, H.T. "Experimental Studies in Vocal Expression" Journal of Applied Psychology VIII, 1924, p 23.

On the subject of the pitch of the voice in oral reading, little has been written. One study by Charles H. Woolbert [1] concerning the pitch of the voice and the effectiveness of the reading was performed some years ago, and although the results are not of great concern here, he concludes that the greater the range of pitch, the more pleasing and effective is the reading.

This summarizes the research pertinent to the present investigation, which has as its purpose the study of the pitch of conversation and oral reading of fourth grade children in an attempt to determine the effect of difficult reading on the pitch of the voice, and to attempt to determine how reliably the pitch of the speaking voice was evaluated by observational methods.

[1] Woolbert, C.H. "Effects of Various Modes of Reading" Journal of Applied Psychology IV, 1920 No.2 p.162

GENERAL DESCRIPTION OF THIS INVESTIGATION

General Description of this Investigation

This study was undertaken with 31 pupils in a fourth grade of the Medford Public Schools, although, due to unusual circumstances, the number on whom complete data has been obtained, is but 29. There were 13 boys and 16 girls, with a chronological age range of 105 months to 137 months. As measured by the "Metropolitan Achievement Test" (see Table A, Appendix) the group score from average to superior, although the predominant language background of these pupils, as well as nativity in three instances, is foreign. The location of the school is in a semi-commercial zone, and the parental occupation is, in most instances, unskilled labor.

This investigation required the electrical recording of spontaneous natural conversation, and the oral reading and recall of selected passages from three paragraphs of the "Durrell Analysis of Reading Difficulty", (paragraphs 2,4, and 6 of 'Oral Reading, Unaided Oral Recall'.) These paragraphs are numbered according to grade levels. The recording equipment used was the type D-7 recording machine, manufactured by the Presto Recording Company, New York City. A concealed crystal microphone was attached to this machine.

After a preliminary investigation, with a different fourth grade, it was determined that natural conversation could not be obtained if: (1) evidences of recording were present, and (2) the conversation was held by the examiner

and one child alone, or by two children and the examiner. It seemed expedient at this point to adopt the following routine:

(1) A small airy room was selected, to which a closet of adequate size was connected by botha door and a window. In this closet was placed all the recording equipment. The room itself was furnished with a rug, desk, chairs, lamps, and books, to make the surroundings as attractive and as physically comfortable as possible.

(2) The microphone was concealed in a desk lamp, and placed on the desk about a foot removed from the subjects' chair. The cord connecting the microphone to the recording machine was concealed under the rug, and ran to a corner, out of the subjects' line of vision, through a window and into the closet.

(3) By arrangement with the home room teacher, pupils were sent to this testing room in groups of two. It had been our intention to pair off the girls with the boys in order to eliminate difficulty in the identification of voices from the records, but this plan had to be abandoned, since the boys in the group were extremely reticent in carrying on a conversation with the girls. Thus, after the first two records, the children were paired off on the basis of comradship, rather than on sex.

(4) Each pair of pupils was met in the corridor by the examiner, who escorted the children to the testing room. Inside the room, the pupils were seated in chairs that already had been carefully placed in reference to the

microphone. It was here explained that the purpose of this examination was to determine if any reading progress had been made since the administration of a reading achievement test by the examiner a month before. Each child was definately told that this test would not affect his school grades in the slightest, and any results obtained were to be used only in a very general way. This statement was not made any more specific nor comprehensible.

(5) At this point, the examiner asked if either of the children had seen Miss "C." - the elementary supervisor - who, it was stated, was expected to visit the examiner sometime during the course of the reading, but had not yet appeared. On receiving no information, the examiner asked to be excused, and stated that he was going to telephone Miss "C.", and also to speak to the principal, but would return in five or six minutes. This rather weak excuse for leaving the room was varied several times, in the event that pupils once back in the home room would relate to one another their experiences with the examiner. The pupils were asked not to leave the chairs upon which they were sitting and wander about the room, since the office was not the property of the examiner, and if anything were broken or disturbed, the consequences would be embarassing for all concerned. The examiner then left the room.

(6) Recording of the pupil's conversation was begun four or five minutes after the examiner had left, the time interval varying somewhat according to the volubility of

the subjects' conversation. On no occasion was the recording begun until four minutes had elapsed, although with six children it was necessary to remain out of the room as long as ten minutes. Four minutes after the examiner had left the room was rather arbitrarily selected as the time to begin recording, since it was felt that during this interval the subjects would become somewhat acclimatized to this situation, would neither whisper nor move away from their microphone position, and would employ in any ensuing conversation a normal pitch level. This assumption of acclimatization seems to have been proven quite true for this group, if we may take as our criteria the wide, and occasionally amusing, range of conversational material unrelated to the testing situation which our records distinguish.

(7) When sufficient natural conversation had been obtained, the assistant signaled the examiner, who promptly entered the room. No comment was made other than a brief apology for the delay. The names and ages of the subjects were secured and noted. The examiner then suggested that inasmuch as this was an individual test, and the same material was to be read at sight by both children, one of the pupils should leave the room and wait in the corridor where a chair had been provided.

(8) Before beginning reading, the child was told that he was to read aloud two paragraphs, and to tell the examiner all he could remember about them. It was further stated

that if he were to read these two well, he might be allowed to attempt a sixth grade paragraph, "just for fun". As each child read, his errors were scored by the examiner, and the time and the number of ideas in his recall was noted. While the child was reading, certain selected sentences in the reading were permanently recorded. The sentences to be recorded had previously been selected on the following bases:

(A) Position of the sentence in the paragraph. (It was desired not to select sentences near the beginning of the paragraphs, since both the newness of the situation and unfamiliarily with the material might cause artificial pitch levels.)
(B) Repetition of some of the words in each of the sentences. The words "a" and "he" occur in all three sentences, "was", "to" and "when" occur in two.
(C) Number of vowel sounds. To many of the consonants, especially the gutterals, it is difficult to assign difinite pitches. If our material to be analysed could contain a minimun of these, our material would be less difficult to evaluate.

The complete paragraphs read, and the sentences recorded from each, may be found in the appendix, page ii.

(9) After each child had read and had stated as accurately as possible the content of each paragraph, including the sixth grade paragraph, he was asked to exchange places with the child waiting in the corridor. He was urged to tell the other child the nature of the test, and whether or not he thought it difficult. Since the general spontaneous comment was to the effect that the test was far less difficult then imagined, and since the child in the corridor might, by this time, be considerably apprehensive of the

interview, this was thought wise. When the other child had entered and been seated, the examiner repeated the same introductory comments, not mentioning, unless directly questioned, whether the previous child had succeeded in reading the sixth grade paragraph. The motivating force of this device, merely calculated to soothe any feeling of insecurity or apprehension, was considerable, for by the end of the day, those children who had not yet read volunteered to remain after school as long as necessary to see if they, too, could read well. This, of course, was not permitted, since the fatigue factor and the general high feeling might have invalidated the results. (10) The order of the paragraphs to be read was changed slightly for those children numbered on the records as "B". Paragraph 4 was presented first, paragraph 2 was read second, and paragraph 6 was presented last. In records numbered as "A", the order is paragraphs 2,4 and 6. In records from 12A to 15C - when the examination took place the next morning - the paragraphs were presented in this order: Paragraph 6, first, paragraph 2, second, and paragraph 4, third. These irregularities in procedure were permitted in order that we might observe the effect on the pitch of the voice if the children read difficult material first.

In summary: all children numbered as "A" - from record

1A up to but not including 12A - read in the order named, paragraphs 2, 4 and 6. All children numbered as "B" - from record 1B up to, but not including 11B - read in the order named, paragraphs 4, 2, and 6. All children from 12A to 15C read the paragraphs in this order: 6, 2,4. All children read the same paragraphs during the course of the examination, although the order varied throughout.

(11) The last three children - records 15A, B, C - were allowed to sit in the room together, since it would have been impossible to obtain conversation from "C" had "A" and "B" first been paired off, leavin "C" without a converational partner. With three pupils in the room, the conversation was much more spirited, although in matching the conversation to the reading, more difficulty was experienced.

(12) The records on two children (numbers 2B and 14B) are not treated in the data here, inasmuch as on child whispered in the conversation, and the other had left his chair and walked about the room while talking.

(13) The testing and recording for this experiment consumed one and one-half days.

Procedure in the Analysis of Data

When all the records had been obtained, the problem of how best to analyse the pitch, whether by empirical or scientific methods, presented itself. For several reasons, it was decided to use the purely subjective method of judgment by three qualified judges instead of the

more reliable method of analysis by a stroboscopic or phonophotographic apparatus.

The first consideration in this decision was entirely financial. One could either have built or purchased the necessary equipment, or have the analysis made by a commercial company. The equipment may be purchased from the Vitagraph Company of New York City at a cost slightly in excess of one thousand dollars. The Massachusetts Institute of Technology (Professor Norman Bennett) was quite willing to cooperate in the construction of a type of cathode ray oscillograph, but with this type of device, aproximately fifteen miles of film would be required to photograph the speech vibrations, and the data thus yielded would entail a thousand separate measurements. This type of apparatus was the only type then available in view of the limited time of the students who would construct the machine, and considering also the laboratory equipment not already in use.

The Western Electric Company (Mr. O. Carpenter, Educational Representative had, at one time, an experimental apparatus which would give precisedly the measures desired, but it is no longer available for outside research. Professor F.V. Hunt, Cruft Laboratory, Harvard University, had a similar machine, at present, however, reassembled to form a part of the mechainism of another type of apparatus of quite dissimilar function. Professor Joseph Tiffin of Purdue University had the necessary equipment, but the cost of having this data

analysed commercially is aproximately fifteen dollars per minute of speech.

A second consideration of equal weight in the discussion of how best to analyse the data, was the possibility that a genuine contribution to the speech field might be made if the data were to be treated experimentally as a study in the perception of speech sounds, attempting to substantiate to some extent the work of Alfred R. Root.[1]

In view of the above, it was decided that the procedure in analysis would be as follows:

(1) The obtained records were to be re-recorded, with selected conversation and the reading and recall of three paragraphs on each separate record. The original records were played back until it was definitely established which conversational voice belonged with which reading and recall. (There is no question in the author's mind that this was not satisfactorily accomplished throughout.) From the original conversation was re-recorded five syllables of conversation, reading and recall in each level, pains being taken that only typical passages should be selected.

(2) Three judges with "absolute" pitch were chosen to evaluate the records. Two of the judges were referred to the writer by their professors at the Boston University School of Music on the bases of both their classroom performance and their scores on the Seashore Test of Musical Talent. The third judge volunteered her services,

and her score was found to compare favorably with the scores of the other judges on the Seashore Test. The scores of the judges, for pitch only, are:

Judge 1 - 93
Judge 2 - 89
Judge 3 - 89

(3) Because of the possibility of biased data in the author's selection of typical passages in the re-recording of data, these newer records were not used in the initial judgments, instead, the judges heard once the entire first record, then selected themselves the typical passages to be analysed. From this sentence, a five syllable phrase was chosen as a representative sample of the pitch employed through the selection. This selected passage was played back several times, then the needle of the phonograph was made to retrace successively each syllable or one-syllable word until the judges had either matched the note to a piano (tuned to A=440~) or judged without recourse to the instrument the pitch of the syllable. After the judges had given the pitch for each of the syllables, the passage was played again.

(4) The method used by each observer in judging the pitch is, perhaps, best told by themselves.

Judge 1

"First I heard the syllable, then I sang the pitch I heard to myself. I know from tonal memory the location of A on the scale, and I related the pitch I was singing to A. In a slide, I first listened for the initial note. Once I heard this, I knew whether the next note or perceptible pitch was

higher or lower, and whether it was a half or a quarter above or below the semi-tone, as it often was.

Judge 2

"When you (the author) played the part first, I would pick out the first low note, then the high note. This gave me the limits of the pitch. Then I would listen to the note that kept playing over and over. I compared this with the low note that I first heard. If it was a word with a slide in it, like the first syllable of 'bicycle', I listened for the first pitch in the slide, then when I had this, I could tell how far up the scale the slide went. Sometimes I matched it to the piano, when I was uncertain. After you have listened to a few, though, you can pick out the little shadings of tone quite easily."

Judge 3

"In the case of unaccented syllables I experienced no difficulty in determining the pitch, but in the accented syllables there was often a tendency for the pitch to slur over several tones before reaching its crest. In these instances, an attempt was made to discriminate the dominant pitch, or if this was impossible, to note the beginning and termination of the slide. These I marked."

The method of Judge 1 is a common one, and although the other judges are not so specific in stating their methods, it remains that each must have a tonal memory of some note, against which they matched the pitch of the syllable under discussion. An attempt to sing the note may result in misplacing the note by an octave, if the observer is feminine, and attempting to analyse a bass voice. The note is observed with accuracy, but the octave depends upon the observer's range. Since, in this investigation, the subjects are all children, and the judges all women whose voices could easily encompass the range exhibited by the children, this difficulty is present, but not to the

extent it might have been had other groups been under discussion.

The process of first choosing a typical passage, hearing the passage several times, hearing the pitch of the single syllables until its pitch was observed with accuracy, then listening to the entire passage once again was repeated seven times for each child in order to establish the average pitch levels of conversation, oral reading of three paragraphs, and the recall from each of these paragraphs.

(4) When the judgments had been collected and tabulated, the agreement between the judges was so close that further investigation to determine the correlation between successive judgments was necessary. This time, each judge met the writer individually. Each was asked to go through the identical procedure, this time, of course, with no recourse to other person's judgments in the event of indecision. The first judge demurred when asked to select again a typical passage, stating that since a five-syllable typical passage had been first selected by the group, it was quite possible that an individual might select another phrase, equally as representative of the entire selection, but one that would contain a different order of tones, thus invalidating any attempted comparison between judgments. The specific syllables upon which judgment for pitch was first obtained were, unfortunately,not written down, hence, it was impossoble to later determine exactly which passages in the record had been used. It would have been possible to have

the judges pick again an average passage, analyse this, then average these pitches and compare them with the averaged pitches of their first judgments. This, however, was thought unwise, since the pitch level varies so slightly for each child from sample to sample, though markedly for the same child in different samples, that any correlation of averaged passages would be, by chance alone, extremely high.

It was largely for the above reason that the author's selections of typical passages, which had already been re-recorded was used. In addition, it had been noted by the author during the first group analysis that the judges were selecting many samples from these records which the author himself had selected, although how many, was at this point undetermined.

When all the judgments had been tabulated, it was found that 90 of the 105 syllables were identical, i.e., 18 out of the 21 passages had been selected by both the author and the group of judges as typical samples. It was then possible to correlate for the re-identification of pitch, as well as for the agreement between judges. These correlations, as well as the complete table of all judgments used in obtaining them are included further on; the table is in the appendix, and the correlations are presented in the "Analysis of Data", which follows immediately.

ANALYSIS OF DATA

Analysis of Data

The analysis and description of the data accrued during this investigation is here presented in reference to its chronological acquisition, not to its importance or significance in the present problem. It is for this reason that Chart I, indicating the distribution of reading errors made by the group under discussion is presented first.

The errors indicated in this chart - page 30 - were scored during the reading of the passages, and are broken-down to present both the type of error made in each paragraph, and whenever possible, the frequency of that error. That is, Child 1A made five errors in reading Paragraph 2 - three of which were errors on small words, one was a word insertion, and one related to head movements. Owing to a compression of the chart during the photostating process, the data are not as easily readable as had been expected, although as it stands, it is capable of revealing much of the nature of the reading of this group.

The purpose in making such a chart was two-fold: (1) it was desired to record simply and graphically the errors of each child for each paragraph, and (2) it was desired to indicate the oral reading ability of the group - an ability not specifically measured by the "Metropolitan Achievement Test".

In an effort to further determine if the very small group of fourth graders used in this study be representative

Distribution of Reading Errors Shown by 29 Fourth Grade Pupils on Paragraphs 2, 4, 6 of Durrell Analysis of Reading Difficulty

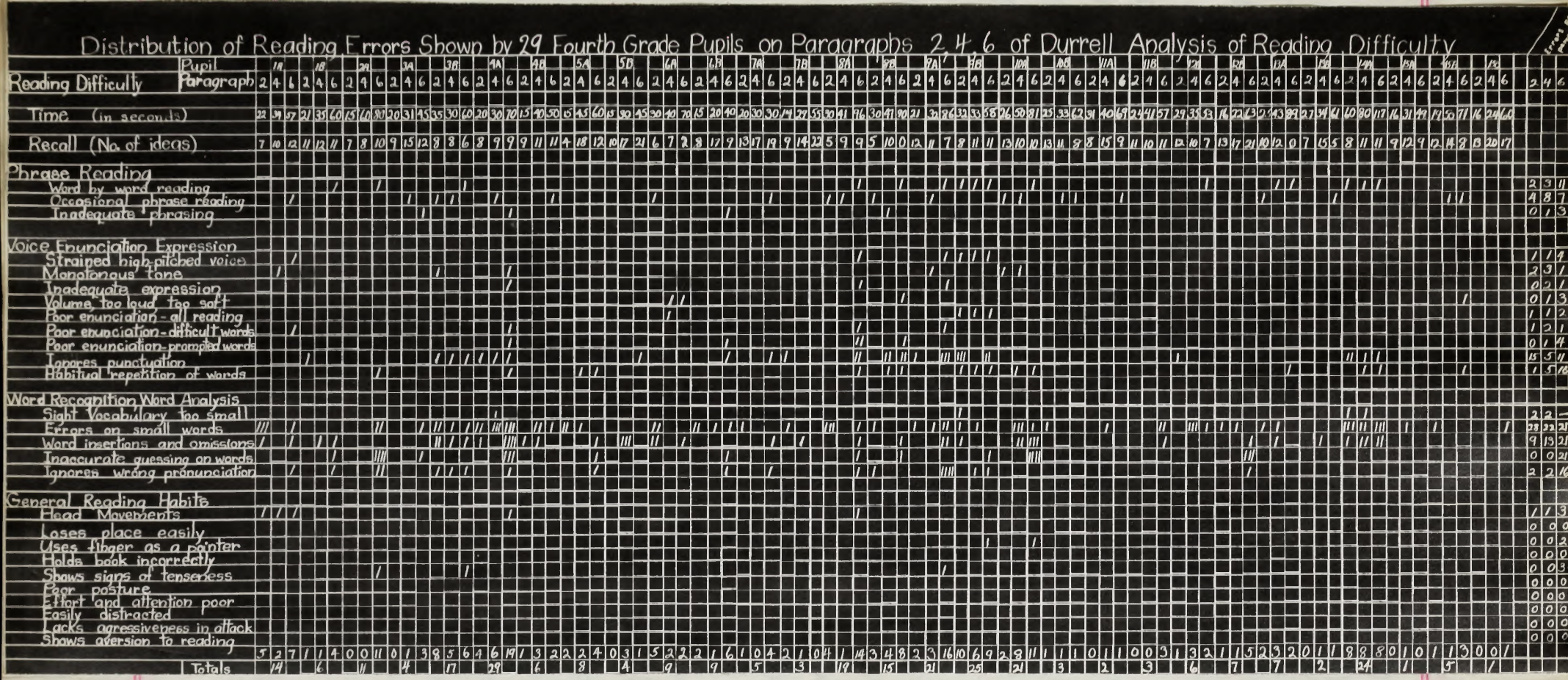

CHART I

of an "average" fourth grade, the reading errors were converted into percentages. These percentages are ranked with the percentages obtained from two other investigations [1] which studied the quality of fourth grade reading by means of the same test paragraphs. [2] The results of this are shown in Table I, page 32.

At first surveyal, the discrepencies between the three investigations appear rather startling, although the reason for this is soon obvious. Every comment listed by the test author is a subjective comment, and since the criteria for these commemts, for instance "occasional phrase reading", is not listed in the studies, it is quite possible that the errors listed by Durrell have been misinterpreted by any one of the three investigators. There is a closer agreement between Burns and Adams than between this investigation and either of the former, indicating both of the other investigators who worked together, had specific, if unlisted, criteria. In this investigation, the criteria for the subjective comments are listed in the appendix.

Pages 33, 34 and 35 (Table II) contain more or less raw data, unrefined by interpretation. The contents, however, are interesting enough and significant enough to warrant the placing of these data here.

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[1] Burns, B."Diagnostic Study of Reading Difficulty in Fourth Grade" Unpublished Master's Thesis, B.U.,1938
Adams, P."Study of Individual Differences in Fourth Grade" Unpublished Master's Thesis, B.U., 1938

[2] "Durrell Analysis of Reading Difficulty", Donald D. Durrell World Book Company, N.Y. 1933

Table 1

Showing the Percentage of Reading Errors Reported in This Investigation (C) and Those Reported in the Investigations of Burns (B) and Adams (A)

Reading Error	C	B	A
Phrase Reading			
Word-by-word	.31	.10	.05
Occasional Phrase Reading	.58	.22	.46
Inadequate Expression	.13	.03	.11
Voice, Ennunciation, Expression			
Strained, high-pitched voice	.13	.06	.31
Monotonous tone	.21	.14	.41
Inadequate expression	.07		
Volume too loud	.03	.06	.07
Volume too soft	.07		.10
Poor Ennunciation-all reading	.07	.28	.02
" " -difficult words	.13	.06	.26
" " - prompted words	.17	.11	.14
Ignores Punctuation	.55	.11	.02
Habitual Repetition	.27	.71	.14
Word Recognition			
Sight vocabulary too small	.10	.01	.05
Errors on smaller words	.93	.35	.58
Word Insertions and Omissions	.58	.50	.34
Ignores wrong pronunciation	.34	.28	.68
General Reading Habits			
Head Movements	.10	.68	.56
Uses finger as pointer	.07		
Tenseness evident	.07	.58	.25
Number	29	143	143

Pitch Ratings of Three Judges on Five Selected Syllables of Conversation and on Three levels of Reading and Recall

	Conversation			Reading II			Recall II			Reading IV			Recall IV			Reading IV			Recall IV		
Judge	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Record	F'	F'	F'	D#	D#	D#	C#	C#	C#	A#	A#	A#	D#	D#	D#	D#	D#	D#	C#	C#	C#
	E'	E'	E'	A#	A#	A#	D#	D#	D#	A#	A#	A#	A#	A#	A#	B.	B.	B.	C#	C#	C#
IA	E'	E'	E'	A#	A#	A#	B.	B.	B.	A#	A#	A#	A#	A#	A#	A#	A#	A#	A	A	A
	E'	E'	E'	E	E	E	B.	B.	B.	G	G	G	F#	F#	A#	A#	A#	A#	G#	G#	G#
	F'	F'	F'	F	F	F	C#	C#	C#	A#	A#	A#	D	D	D	A#	A#	A#	G#	G	G
	D	D	D	D#	D#	D#	B.	B.	B.	B.	B.	B.	C	C	C	C	C	C	D#	D#	D#
	D	D	D	C	C	C	C	C	C	C	C	C	C#	C#	C#	G'	G'	G'	A#	A#	A#
IB	D	D	D	B.	B.	B.	B.	B.	B.	F.	F.	A#.	C	C	C	G#	A#	G#	D	D	D
	F	F	F	C	C	C	C#	C#	C#	D	D	D	F	F	F	G#	G#	G#	B.	B.	B.
	E	E	E	C	C	C	C	C	C	C	C	C	F	F	F	G#	G#	G	D	D	D
	F	F	F	G	G	G	A#	A#	A#	G	G	G	G#	G#	G#	C'	C'	C'	G#	G#	G#
	F	F	F	B.	B.	B.	C#	C	C#	G	G	G	C'	C'	C'	B	B	B	G#	G#	G#
2A	D	D	D	G	G	G	A#	A#	A#	A	A	G#	B	B	B	B	B	B	G#	G#	G#
	C	C	C	E	E	E	A#	A#	A#	A	A	A	B	B	B	B	B	B	A#	A#	A#
				G	G	G	A	A	A	G	G	G	B	B	B	G	G	G	A#	A#	A#
	D	D	D	C	C	C	E	E	E	D#	D#	D#	G	G	G	D#	D#	D#	B.	B.	B.
	G	G	G	D	D	D	G	G	G	D#	D#	D#	G#	G#	G#	C#	C#	C#	B.	B.	B.
3A	E	E	E	D	D	D	F#	F#	F#	D#	D#	D#	A	A	A	G	G	G	C#	C#	C#
	F	F	F	D#	D#	D#	F	F	F	C	C	C	A	A	A	A	A	A	C	C	C
	E	E	E	D	D	D	E	E	E	D	D	D	F#	F#	F#	G	G	G	D	D	D
	F#	F#	F#	D	D	D	D	D	D	C#	D	C#	C#	C#	C#	C	C	C	C	C	C
	F#	F#	F#	D	D	D	B	B	B	A#	A#	A#	C	C	C	A	A	A	B.	B.	B.
3B	D#	D#	D#	D	D	D	A#	A#	A#	G	G	G	B.	B.	B.	C'	C'	C'	B.	B.	B.
	B.	B.	B.	D	D	D	B	B	B	G	G	G	B.	B.	B.	B	B	B	C	C	C
	C	C	C	D	D	D	A#	A#	A#	G	G	G	C	C	C	A#	A#	A#	D#	D#	D#
	G#	G#	G#	D#	D#	D#	E	E	E	F#	F#	F#	B.	B.	B.	D	D	D	C	C	C
	G#	G#	G#	D#	D#	D#	A#	A#	A#	F	F	F	C	C	C	D	D	D	B.	B.	B.
4A	C'	C'	C'	C	C	C	G	G	G	E	E	E	C	C	C	E	E	E	D	D	D
	C'	C'	C'	G	G	G	F	F	F	C	C	C	C	C	C	B.	B.	B.	C	C	C
	C'	C'	C'	C	C	C	E	E	E	B.	B.	B.	E	E	E	D	D	D	C	C	C
	D	D	D	A	A	A	C#	C#	C#	C#	C#	C#	D#	D#	D#	D#	D#	E	F	F	F
	B.	B.	B.	A#	A#	A#	C#	C#	C#	D	D	D	D	D	D	E	E	E	E	E	E
4B	B.	B.	B.	F#	F#	F#	C#	C#	C#	C	C	C	D	D	D	E	E	F	E	E	E
	A	G#	G#	D#	D#	D#	D#	D#	D#	C	C	C	D	D	D	E	E	F	D	D	D
	B	B	B		F	F	C#	C#	C#	C	C	C	D	D	D	E	E	F	E	E	E
	E	E	E	D	D	D	E	E	E	E	E	E	G	G	G	G	G	G	F	F	F
	G	G	G	E	E	E	C	C	C	G	G	G	D	D	D	G	G	G	G	G	G
5A	F#	F#	F#	E	E	E	B.	B.	B.	E	E	E	E	E	E	G	G	G	D	D	D
	D	D	E	F	F	F	B.	B.	B.	E	E	E	D#	D#	D#	G#	G#	G#	E	E	E
	E	E	E	E	E	E	F	F	F	G	G	G	D	D	D	G	G	G	F#	F#	F#
	A	A	A	F#	F#	F#	C'	C'	C'	A#	A#	A#	A#	A#	A#	D#	D#	D#	C'	C'	C'
	G#	G#	G#	G	G	G	B	B	B	A#	A#	A#	B	B	B	D#	D#	D#	A#	A#	A#
5B	G	G	G	G	G	G	A	A	A	A#	A#	A#	B	B	B	D#	D#	D#	G#	G#	G#
	C	C#	C	B	B	B	B	B	B	A#	A	A#	B	B	B	D#	D#	D#	D	D	D
				B	B	B	B	B	B	A#	A#	A#	B	B	B	C#	C#	C#	D	D	D
	B.	B.	B.	B	B	B	A	A	A	A	A	A	A	A	A	A#	A#	A#	A#	A#	A#
	A.	A.	A.	A#	A#	A#	A	A	A	G.	G.	G.	F#	F#	F#	B	B	B	G#	G#	G#
6A	B.	B.	B.	G#	G#	G#	G#	G#	G#	G	G	G	G	G	G	C'	C'	C'	G	G	G
	A#.	A#.	A#.	B	B	B	G#	G#	G#	A	A	A	B	B	B	B	B	B	A#	A#	A#
	B.	B.	B.	B	B	B	A	A	A	A#	A#	A#	A	A	A	B	B	B	A#	A#	A#
																			D#	D	D

Pitch Ratings of Three Jugdes on Five Selected Syllables of Conversation and on Three Levels of Reading and Recall

	Conversation			Reading II			Recall II			Reading IV			Recall IV			Reading VI			Recall VI		
Judge	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Record	G♯	G♯	G♯	D'	D'	D'	D	D	D	D	D	F	C♯	C♯	C♯	B	B	B	E	E	E
	A	A	A	E'	E'	E'	A♯	A♯	A♯	F	F	C♯	B	B	B	G♯	G♯	G♯	G	G	G
6B	F	F	F	C♯'	C♯'	C♯'	B	B	B	C♯	C♯	C♯	D	D	D	B	B	B	F♯	F♯	F♯
	G♯	G♯	G♯	D'	D'	D'	A♯	A♯	A♯	C	C	C	C♯	C♯	C♯	B	B	B	F	F	F
	G	G	G	D♯'	D♯'	D♯'	B	B	B	D	D	D	C	C	C	B	B	B	E	E	E
	B.	B.	B.	F♯	F♯	F♯	C	C	C	F	F	F	C♯	C♯	C♯	D♯	D♯	D♯	D♯	D♯	F
	A.	A.	A.	E	E	E	C♯	C♯	C♯	E	E	E	C	C	C	F	F	F	F	F	D♯
7A	G♯.	G♯.	G♯.	D♯	D♯	D♯	E	E	E	F♯	F♯	F♯	A.	A.	A.	D♯	D♯	D♯	C	C	C
	A♯.	A♯.	A♯.	C♯	C♯	C♯	D♯	D♯	D♯	G	G	G	B.	B.	B.	D♯	D♯	D♯	E	E	E
	B.	B.	B.	F	F	F	C	C	C	F♯	F♯	F♯	C	C	C	D♯	D♯	D♯	D	D	D
	C	C	C	C♯	C♯	C♯	C♯	C♯	C♯	F	F	F	A.	A.	A.	A	A	A	C	C	C
	B.	B.	B.	A.	A.	A.	B.	B.	B.	B	B	B	B.	B.	B.	A	A	A	D♯	D♯	D♯
7B	E	E	E	G	G	G	G♯.	G♯.	G♯.	A	A	A	B.	B.	B.	G♯	G♯	G♯	F	F	F
	D♯	D♯	D♯	G♯	G♯	G♯	A.	A♯.	A♯.	A	A	A	A♯	A♯	A♯	G♯	G♯	G♯	B.	B.	B.
				A	A	A	B.	B.	B.	A	A	A	B.	B.	B.	G♯	G♯	G♯	D♯	D♯	D♯
	F♯	F♯	F♯	F♯	F♯	F♯	D	D	D	G♯	G♯	G♯	C	C	C	E	E	E	D	D	D
	F	F	F	D	D	D	D	D	D	E	E	E	F	F	F	D'	D'	D'	C♯	C♯	C♯
8A	E	E	E	F	F	F	F	F	F	B	B	B	E	E	E	D'	D'	D'	D	D	D
	D	D	D	F	F	F	E	E	E	A♯	A♯	A♯	D♯	D♯	D♯	E'	E'	E'	D♯	D♯	D♯
	D♯	D♯	D♯	F	F	F	E	E	E	A	A	A	E	E	E	C♯'	D'	C♯'	D	D	D
	E	E	E	B.	B.	B.	B.	B.	B.	C	C	C	C	C	C	E	E	E			
	B.	B.	B.	A.	A.	A.	G	G	G	A♯.	A♯.	A♯.	E	E	E	G	G	G			
8B	C	C	C	A♯.	A♯.	A♯.	E	E	E	A♯.	A♯.	A♯.	D	D	D	F♯	F♯	F♯	No Recall		
	D	D	D	B.	A♯	B.	E	E	E	B.	B.	B.	D	D	D	F	F	F			
	C♯	C♯	C♯	B.	B.	B.	D	D	D	B.	B.	B.	E	E	E	E	E	E			
	B.	B.	B.	D♯	D♯	D♯	D♯	D♯	D♯	D♯	D♯	D♯	D♯	D♯	D♯	D♯	C♯'	C♯'	C♯'	B	B	B
	D	D	D	D	D	D	A.	G♯.	A.	D	D	D	D♯	D♯	D♯	E'	E'	E'	A	A	A
9A	C'	C'	C'	C	C	C	D	D	D	B.	B.	B.	D♯	D♯	D♯	D♯	F	E	A	A	A
	D	D	D	F	F	F	D♯	D♯	D♯	F	F	F	D	D	D	F'	F'	F'	A♯	A♯	A♯
				D	D	D	E	E	E	F	F	F	D	D	D	E'	E'	E'	C'	C'	C'
	D♯	D♯	D♯	F	F	F	B.	B.	B.	C♯	C♯	C♯	B.	B.	B.	C	C	C	A.	A.	A.
	E	E	E	D♯	D♯	D♯	C♯	C♯	C♯	C♯	C♯	C♯	A♯.	A♯.	A♯.	B.	B.	B.	D♯.	D♯	D♯
9B	D	D	D	D	D	D	D	D	D	A♯.	A♯.	A♯.	B.	B.	B.	D	D	D	D	D	D
	D♯	D♯	D♯	D	D	D	C♯	C♯	C♯	C	C	C	B.	B.	B.	B.	B.	B.	C♯	C♯	C♯
	D	D	D	D	D	D	D	D	D	A♯.	A♯.	A♯.	C♯	C♯	C♯	D	D	D	D♯	D♯	D♯
	C♯	C♯	C♯	F	F	F	D	D	D	D♯	D♯	D♯	D	D	D	G	G	G	C♯	C♯	C♯
	F♯	F♯	F♯	D♯	D♯	D♯	F	F	F	D	D	D	A	A	A	F♯	F♯	F♯	D♯	D♯	D♯
10A	B.	B.	B.	D	D	D	E	E	E	A♯.	A♯.	A♯.	F	F	F	A♯	A♯	A♯	D	D	D
	C♯	C♯	C♯	B.	B.	B.	D♯	D♯	D♯	G	G	G	D	D	D	B	B	B	B.	B.	B.
	D	D	D	A.	A.	A.	D	D	D	G	G	G	C♯	C♯	C♯	C♯	C♯	C♯	C	C	C
	D	D	D	F♯	F♯	F♯	E	E	E	F	F	F	D♯	D♯	D♯	E'	E'	E'	A	A♯	A♯
	B.	B.	B.	B	B	B	B	B	B	B	B	B.	B.	B.	E'	E'	E'	F♯	F♯	F♯	
10B	A.	A.	G♯.	G	G	G	G	G	G	A♯	A♯	A♯	F	F	F	E'	E'	E'	D	D	D
	B.	B.	B.	F	F	F	B	B	B	C'	C'	C'	E	E	E	E'	E'	E'	G♯.	G♯.	G♯.
	C♯	C♯	C♯	E	E	E	B	B	B	C♯'	C♯'	C♯'	D♯	D♯	D♯	F'	E'	E'	G.	G.	G.
	A♯.	A♯.	A♯.	E	E	E	C♯	C♯	C♯	G♯	G♯	G♯	D♯	D♯	D♯	D♯	D♯	D♯	D♯	D♯	D♯
	G♯.	G♯.	G♯.	G	G	G	D♯	D♯	D♯	E	E	E	D	D	D	G	G	G	C♯	C♯	C♯
11A	C	C	C	G	G	G	F♯	E♯	E♯	A	A	A	C	C	C	B	B	B	C	C	C
	D	D	D	D♯	D♯	D♯	E	E	E	A♯	A♯	A♯	C♯	C♯	C♯	B	B	B	C♯	C♯	C♯
	B.	B.	B.	F	F	F	G	G	G	A	A	A	D	D	D	B	B	B	D♯	D	D

Pitch Ratings of Three Judges on Five Selected Syllables of Conversation and on Three Levels of Reading and Recall

	Conversation			Reading II			Recall II			Reading IV			Recall IV			Reading VI			Recall VI		
Judge	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Record	D	D	D	F#	F#	F#	E	E	E	F	F	F	D#	D#	D#	F	F	F	D'	D'	D'
	B.	B.	B.	A#	A#	A#	C#	C#	C#	C	C	C	B.	B.	B.	D#	D#	D#	C'	C'	C'
11B	C#	C#	C#	G#	G#	G#	C#	C#	C#	D#'	E'	D#'	C#	C#	C#	D	D	D	G	G	G
	D	D#	D	A	A	A	C#	C#	C#	A#	B	B	D#	D#	D#	G	G	G	F#	F#	F#
	D#	D#	D#	A#	A#	A#	D#	D#	D#	G'	G	E'	D	D	D	G#	G#	G#	F	F	F
	D#	D#	D	F	F	F	C	C	C	B.	B.	B.	A#.	A#.	A#.	F	F	F	C	C	C
	A#	A#	A	D#	D#	D#	A#	A#	A#	A#.	A#.	A#.	B.	B.	B.	G	G	G	A#.	A#.	B.
12A	A#.	B.	A#.	C	C	C	B	B	B	F	F	F	G#.	G#.	G#.	B	B	B	D#	D#	D#
	G#.	G#.	G#.	D#	D#	D#	D	D	D	G	G	G	A.	A.	A.	A#	A#	A#	F	F	F
	G#.	G#.	G#.	E	E	E	F	F	F	G#	G#	G#	A.	A.	A.	C'	C'	C'	C	C	C
	B	B	B	B	B	B	D#	D#	D#	D	D	D	D'	D'	D'	D'	D'	D'	E	E	E
	E	E	E	D	D	D	C	C	C	B	B	B	B	B	B	B	B	B	D	D	D
12B	G	G	G	F#	F#	F#	E	E	E	B	B	B	C#'	C#'	C#'	C#'	C#'	C#'	C	C	C
	G	G	G	A	A	A	G	G	G	B	B	B	D'	D'	D'	B	B	B	A	A	A
	G#	G#	G#	A#	A#	A#	D#	D#	D#	D	D	D	D'	D'	D'	E'	D#'	E'	C	C	C
	B.	B.	B.	E	E	E	D#	D#	D#	D	D	D	B	B	B	B	B	B	E	E	E
	D	D	D	D#	D#	D#	D	D	D	B	B	B	D	D	D	A	A	A	D	D	D
13A	C#	C#	C#	D	D	D	C	C	C	A#	A#	A#	E	E	E	A	A	A	C	C	C
	C	C	C	B.	B.	B.	C	C	C	A	A	A	F	F	F	A	A	A	A	A	A
	B.	B.	B.	D	D	D	C	C	C	B	B	B	E	E	E	A	A	A	D	D	D
	C	C	C	C	C	C	A#	A#	A#	B	B	B	B	B	B	D'	D'	D'	B.	B.	B.
	D#	D#	D#	G#	G#	G#	B	B	B	A#	A#	A#	A	A	A	D'	D'	B	A.	A...	A.
13B	D	D	D	G#	G#	A	C	C	C	C'	C'	C'	G#	G#	G#	E'	E'	E'	C	C	C
	C#	C#	C#	G	G	G	D	D	D	C'	C'	C'	G	G	G	B	B	B	C#	C#	C#
	C	C	C	G	G	G	B.	B.	B.	C'	C'	C'	F#	F#	F#	G	G	G	C	C	C
	D#	D#	D#	C	C	C	C	C	C	A#.	A#.	A#.	B.	B.	B.	B	B	B	B	B	B
	B.	B.	B.	D#	D#	D#	A	A	A	C	C	C	F	F	F	A	A	A	G	G	G
14A	C	C	C	C	C	C	E	E	E	C	C	C	F#	F#	F#	A	A	A	E	E	E
	C#	C#	C#	A	A	A	F	F	F	C	C	C	G	G	G	A#	A#	A#	F#	F#	F#
	D	D	D	E	E	E	F#	F#	F#	C	C	C	G	G	G	A	A	A	F	F	F#
	B.	B.	B.	C	C	C	A#.	A#.	A#.	C	C	C	B.	B.	B.	A#	A#	A#	A#	A#	A#
	A.	A.	A.	C#	C#	C#	G#.	G#.	G#.	A.	A.	A.	E	E	E	B	B	B	C	C	C
15A	A.	A.	A.	D	D	D	B.	B.	B.	C	C	C	F	F	F	B	B	B	B	B	B
	C	C	C	D	D	D	A.	A.	A.	C	C	C	F#	F#	F#	B	B	B	A#	A#	A#
	C#	C#	C#	D	D	D	A.	A.	A.	C	C	C	C	C	C	B	B	B	A	A	A
	F	F	F	D#	D#	D#	D#	D#	D#	D#	D#	D#	C#	C#	C#	B	B	B	C	C	C
	E	E	D#	C#	C#	C	A.	A.	A.	C	C	C	C	C	C	B	B	B	D#	D#	D#
15B	D#	D#	D#	C	C	C	A#.	A#.	A#.	B.	B.	B.	A#	A#	A#	B	B	B	D	D	D
	D#	D#	D#	D	D	D	B.	B.	B.	D	D	D	E	D#	D#	C'	C'	C'	D#	D#	D#
	D#	D#	D#	D#	D#	D#	C	C	C	D	D	D	C#	C	C	B	B	B	D	D	D
	D#	D#	D#	C#	C#	C#	C	C	C	G#	G#	G#	D	D	D	C	C	C	B.	B.	B.
	F#	F#	F#	B.	B.	B.	D	D	D	C#	C#	F#	C	C	C	G	G	G	G#	G#	G#
15C	E	E	E	E	E	E	C	C	C	G#	G#	G#	B	B	B	A	A	A	G	G	G
	D#	D#	D#	F	F	F	A.	A.	A.	G	G	G	A	A	A	A	A	A	F#	F#	F#
	D	D	D	F	F	F	B.	B.	B.	G#	G#	G#	A	A	A	A	A	A	G	G	G

This table (Table II) indicates the judgments of each of the observers for five syllables, typical of the entire passage, from the conversation and from three levels of reading and recall for each child in the investigation. Inspection of this yields many interesting facts.

Perhaphs the most interesting of these is the close approximation of the pitches assigned by each judge. Were these judgments all a result of collaboration, this table would not be surprising, but most of these three thousand judgments here presented were given without recourse to either the other observers or to the piano. Possibly in 400 instances did the observers attempt to collaborate or substantiate their opinions in order to verify their judgments of particularly difficult syllables, but in many of these special instances did they find it difficult to hear the pitch described by another observer, and thus, wrote what she heard.

The first record is a result of collaboration throughout, this largely as a practice device. However, this first record, in which much care was exercised in analysis, contains two deviations in judgments. The one is a five semi-tone variance from the pitch described by two judges (A#, two judges, F#, one judge) and the other is one semi-tone from G(as indicated by two judges) to G# (as judges by the third).

Semi-tone deviations are hardly significant, since throughout the analysis, the judges matched pitches to the nearest note, and if, as in this instance, the pitch of the syllable was mid-way between the two notes, it is of

little import that one assigned the pitch to A# instead of A. The first deviation of five semi-tones cannot be dismissed so easily. This is undoubtedly significant, though the cause is not so apparent. It may have been that a memory of the past syllable (A#) produced the effect of a repetition of the same note - possibly the hallucination effect mentioned by Scripture as an attendant difficulty upon the snalysis of speech by auditory methods. It is possible, also, that fatigue diminished the observer's acuity, but despite the cause, the fact remains that each judge heard the note she described, and could not, in this instance, hear the pitch indicated by the judges who differed in opinion.

After this first record the collaboration or conversation diminished considerably, and thus, by the seventh record, general comparison was negligible. Since no attempt was made to force the judges to remain silent, and they could feel free to ask for other opinions if they so desired, these data cannot be treated as independent observations.

The pitch patterns employed by the children, and as revealed through these judgments, is a complete study in itself, though not here treated. It is interesting to note that in general the children employ the tones of an augmented C major chord in their conversation, while in their reading, most markedly in Paragraph 6, the pitch deviates in each instance so radically from a formal pattern that to assign a major or minor chord as predominent would be arbirtary.

In Paragraph 6 we have tonal patterns that when played are grating to the ear, and patterns that employ great skips in octaves, and frequent unpleasant changes from harmonic to non-harmonic effects. It is indicated in these very small samples of five syllables, that the nearer the voice follows a harmonic melody curve, the less difficult or more pleasing is the speaking, an observation which is substantiated by those of Dionysius of Halicarnassus and Charles A. Woolbert.

Table III presents the seven correlation coefficients for the three judges in the analysis of 90 running syllables of speech. One hundred and five such syllables were originally analysed, but in three instances, different average passages were chosen (as is explained in Chapter II). The differences between average passages in these fifteen syllables were not great differences in pitch, but were marked differences in the order of assigned pitches, hence, when included in the correlations, the true coefficient was considerably distorted. For this reason, those selections for which different representative passages were chosen are here omitted, and the correlation coefficients are presented only for those pitches which each observer judged twice, once with a group, and once individually.

It may be here mentioned that because of the method used (pearson Product-Moment) in obtaining the correlations, the coefficients suffer, since in many instances a correct judgment could have been made to either the semi-tone above or below the note finally indicated as the correct pitch.

Table III

Correlation Coefficients*

A. Correlation of Judges 2 and 3 with 1 (Group Judgment)

Judge 2: r .99 ± .007
Judge 3: r .99 ± .007

Mean r .99

B. Correlation of Judges 2 and 3 with 1 (Individual Judgment)

Judge 2: r .63 ± .04
Judge 3: r .81 ± .02

Mean r .72

C. Correlation of Judges on Re-identification of Pitch

Judge 1: r .80 ± .02
Judge 2: r .65 ± .04
Judge 3: r .70 ± .03

Mean r .72

* for the complete list of data from which these correlations were obtained, see Appendix, pages vii and viii.

Thus, if a note was matched to a natural in the first analysis, and to a sharp in the second analysis - either of which may have been correct - a lowered correlation is the result. This observation holds true for all the correlations, re-identification of pitch as well as for the correlation between judges. It may have been possible to use a different formula to obtain the correlations, but since previous studies utilized the Pearson Product-Moment, with a step interval of one semi-tone (assuming the mid point at the note) it was thought best to follow a similar plan here.

As a standard against which to correlate the judgments of the observers, it was though wise to use the judgments of that observer scoring highest on the Seashore Test (Judge 1). This is, of course, no indication that her judgments were infallible, and it is possible, though undetermined, that in many instances the exact pitch of the syllable was that recorded by the other observers, or perhaps by none of the observers. However, this was the only criterion readibly available, and so was used.

The correlations listed under A - the correlation between the judges on their first analysis - is almost unbelievably high, .98 for both judges. It was because of this remarkable correlation that further investigation was undertaken, although we are assuming that the coefficient for the entire three thousand judgments is not so high.

A partial explanation for this unusual correlation may lie in the sample selected. Records number 1B, 4A and 9B

were used for re-analysis, and hence, for all the correlations because a casual inspection revealed that these three possessed a wide range of pitch, and were so spaced in the order of analysis that for each successive record there was a diminishing collaboration. Further criteria, unfortunately, were entirely capricious.

This mean correlation of .98 exceeds Root's correlation by a considerable difference (/ .03, which at the upper limits is aproximately as great as the difference between two correlations of .01 and .71) However, these two studies may not be directly compared, because in these samples there is always present a varying degree of collaboration between judges, while in Root's investigation, none was permitted.

In direct comparison with the above correlation, we have that obtained on the same syllables, analysed this time entirely individually.(B - the correlation of Judges 2 and 3 with Judge 1, individual judgments) Here, instead of a mean correlation of .98, which conceivably could have been expected again, we have a mean correlation of .72, or a lowering of the mean by twenty-six points. It may be here admitted that the author is somewhat at a loss to account for this. With two of the records in the first analysis there was, of course, an appreciable amount of discussion among the judges, but the practice effect should have compensated for this deprivation of opportunity for consultation. Obviously, it did not.

Our discussion, then, narrows down to this: on two successive correlations between the same judges in the

analysis of the same syllables of speech, one of which was with a group, and one entirely individually, why should there be a lowering of the mean correlation by twenty-six points?

The only possible explanations for this are: (1) - as indicated just above - an unsuspected amount of collaboration between the judges took place, or (2) Judge 1, against whose opinions the judgments of the other observers were evaluated in both instances, was not so accurate on her judgments the second time as she was the first. She could still score the highest for re-identification, yet be far below her previous average. Fatigue, illness -especially a cold which would lessen her auditory acuity - lack of interest or the necessity for haste might account for this.

These two explanations are offered; it is desired that neither be assumed to account in entirety for this discrepency; and it is possible that both play some role in the explanation.

To obtain the correlation for the re-identification of pitch (C), the second judgment of pitch for each observer was correlated with the observer's first judgment on the same syllable. The highest correlation, it will be noticed, is that of Judge 1, who had the highest score on the Seashore Test.

Judges 2 and 3, who had identical scores (89) rank far below Judge 1 on the reidentification of pitch; Judge 3 ranks .10 less than Judge 1, and Judge 2 ranks .15 less.

The deviations between the two successive judgments are not so much the expected semi-tone deviations, but rather

differences of twelve, seven and nine semi-tones. The twelve tone deviations (or one octave) may be accounted for more easily than seven and nine tone deviations, for it seems probable that this misplacing of a note by an octave indicates the judge sang the pitch she was attempting to analyse, and although located the note, misplaced the octave. However, if we assume for a judge the tonal memory of A, a seven semi-tone deviation (viz., a first judgment of G# and a second of C) is indeed difficult to explain.

For C, the mean correlation on re-identification of pitch is .72. In view of the nature of the data, and the difficulties attendant upon the analysis of speech sounds by the ear alone, this correlation, the author feels, indicates an agreement that is above that of mere chance, thus satisfactory for the purposes of this study.

None of the correlations are as high as those obtained by Root, (except the correlation of judgments obtained in the group analysis) but differences in procedure, selection of judges, and other factors probably explain many of the disparities. The use of a reed organ against which the pitch of the syllable was matched, the use of commercial records, which are relatively free from noise, and the small interval of time used in each analysis ($\frac{1}{2}$ hour sittings) undoubtedly contribute to no small degree in raising Root's correlations many points above the correlations secured in this study. In addition, Root differentiated between dominently perceived pitch, and those pitches more elusive to identify, presenting

separate correlations for each. Hence, it is only possible to here indicate that a difference between the two studies does exist, the exact difference in terms of correlation points must remain undetermined.

The mean correlations throughout were obtained by the method outlined by Garrett,[1] which requires the squaring of each correlation, averaging the squares and extracting the square root in order to obtain the mean. With the present correlations, the arithmetic average yields no difference.

It must not be assumed from the above that the author is completely satisfied with the obtained correlations, nor that he feels his explanations of great disparities between judges and judgments is adequate. Quite the contrary is true, for one correlation is too high to compare directly with previous investigations, another too low, and the third but indicative that its' use in this study must be limited. The explanations of many of these phenomena is completely beyond the ken of the author, who has but briefly suggested possible causes, no one of which may be accepted as final. However, the data stands as obtained, and is used through necessity - though with caution - as the only foundation upon which to base any conclusions.

From the analysed samples of Table II, pages 33-35, was taken the average pitch levels of the entire group for the conversation and the three levels of reading and recall. The

[1] Garrett, H.E. Statistics in Psychology and Education 2nd edition, Longmans Green Company, N.Y. 1938, p.284

Figure I

Average Pitch Levels of 29 Fourth Grade Pupils in Conversation and Oral Reading of Three Paragraphs of the "Durrell Analysis of Reading Difficulty"

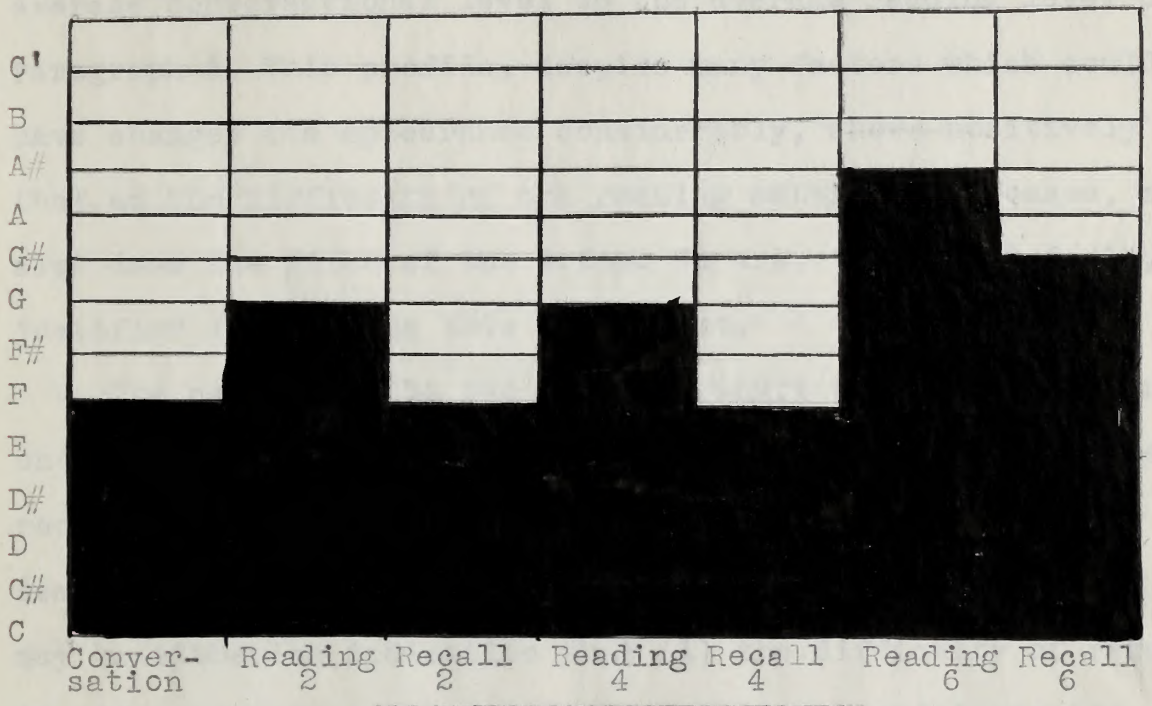
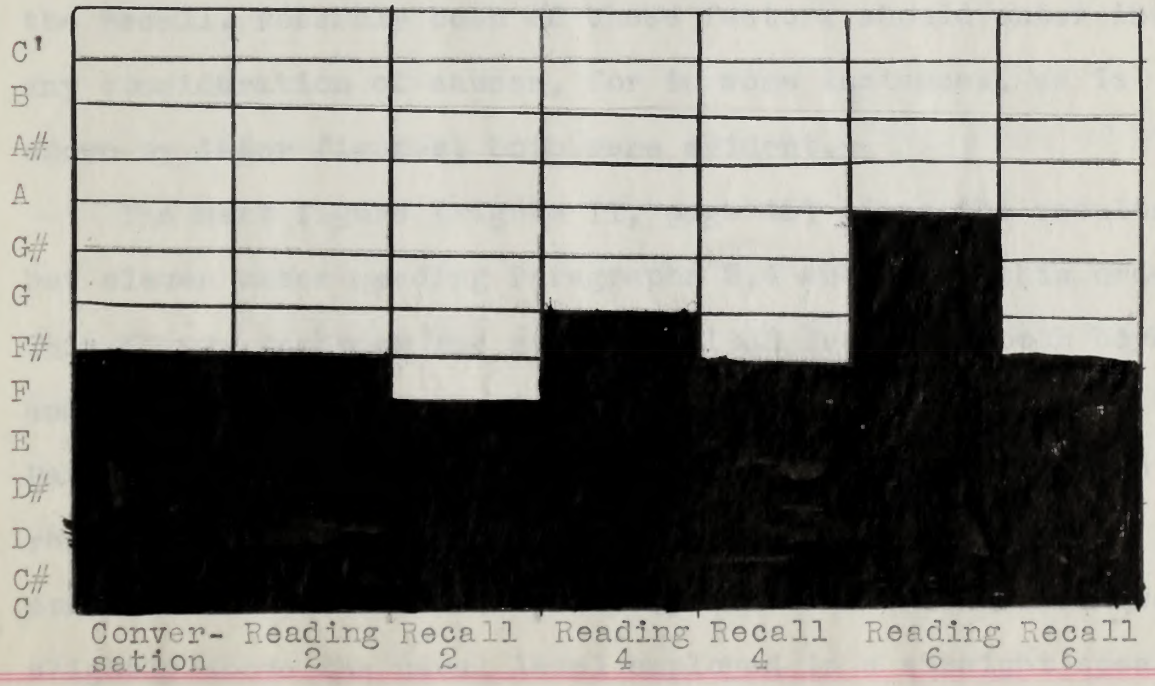
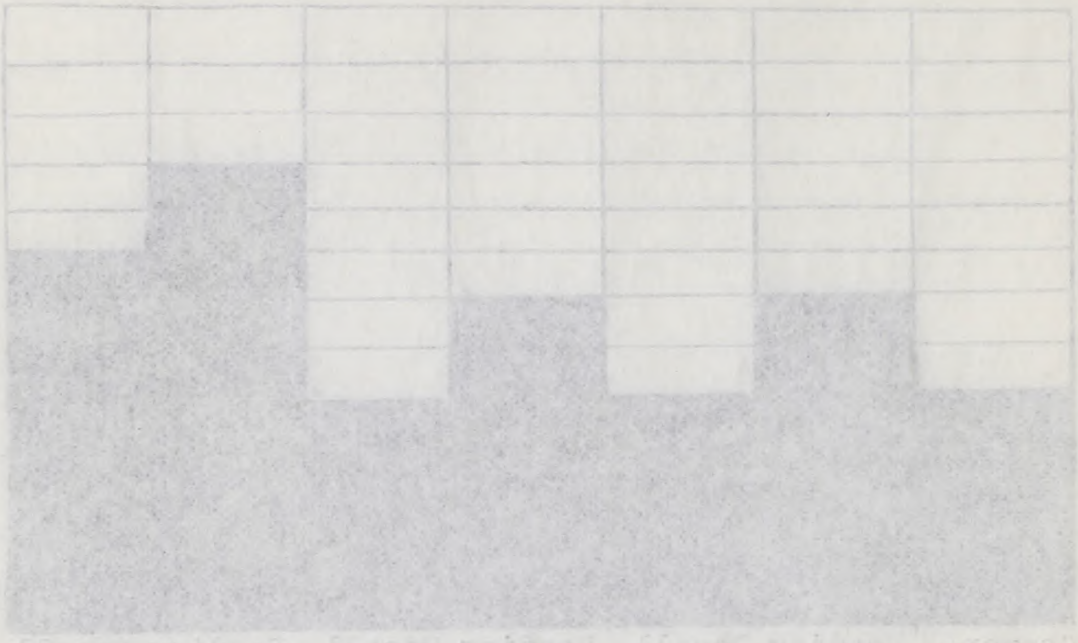


Figure II

Average Pitch Levels of 11 Fourth Grade Pupils in Conversation and Oral Reading of Paragraphs #2,4,6 of the "Durrell Analysis of Reading Difficulty" (in order named)





results of this may be seen in Figure I, page 45. There is, this shows, a gradual but well marked raise in pitch from the average conversational level to the average reading level of Paragraph 6. This profile, despite many factors which could have changes its appearance considerably, shows positively that as the difficulty of the reading material increases, so also does the pitch of the voice. We are, the author feels, justified in assuming this throughout.

The recall of the two less difficult paragraphs remains on the conversational level, naturally enough, although the recall of the sixth paragraph assumes a pitch level three semi-tones above that employed for any other recall. This may be either an indication that (1) the difficulty of recalling the ideas expressed in difficult reading material results in a heightened pitch, or (2) high pitch in the reading of difficult material results in the transfer of this pitch to the recall. Possibly both of these factors should enter into any consideration of causes, for in some instances, as is shown by later figures, both were evident.

The next figure (Figure II, page 45) gives the results of but eleven cases reading Paragraphs 2,4 and 6, in this order. This figure includes the averaged pitch levels of both boys and girls. It is interesting to note that the recall of Paragraph 2 dropped one semi-tone below that of either the reading or the conversation, which indicates that the conversation of some - or possibly all - of the children was slightly above the usual level employed in a straight speaking

situation. Every effort was made to have the situation as normal as possible, although with a laboratory experiment of this type, in which children are employed to obtain average conversational levels of pitch, deviations of this sort may well be expected. The pitch pattern follows in general that obtained for the average level of the group.

When the order of the paragraphs is changed but slightly, as is shown in Figure III (Page 48) presenting the 4th grade level paragraph first, next, the 2nd grade paragraph, and finally the 6th grade paragraph, a smoothing out of the pitch profile is evident. (If comparing directly any two figures, it must be born in mind that the conversational levels may vary, permitting the profiles to be discussed only in terms of semi-tones above or below the obtained conversational level.) By allowing the child to read first the 4th grade paragraph, the pitch was increased three semi-tones over his conversational level - an increase that is equalle, but not exceeded by, the pitch used in the reading of the most difficult material. It may be assumed here that the strangeness of the situation, and other factors discussed below, played an important part with this group in their reading. The pitch level on recall of Paragraph 4 drops back again three semi-tones, thoigh it increases by one semi-tone when reading Paragraph 2. Explanations for the above are not readily evident, but it is known that the children of the group were expecting to read and recall two paragraphs of increasing difficulty. If they succeeded in this, they could be allowed to read a still

Figure III

Average Pitch Levels of 10 Fourth Grade Pupils in Conversation and Oral Reading of Paragraphs #4,2,6 of the "Durrell Analysis of Reading Difficulty" (in order named)

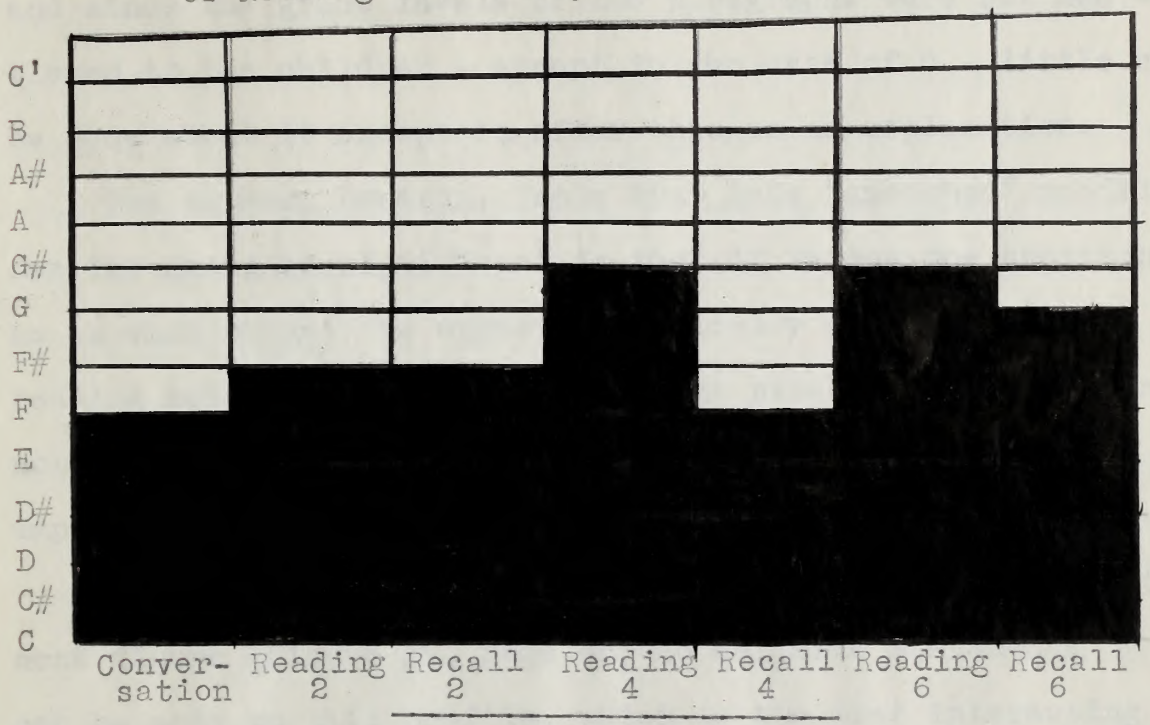
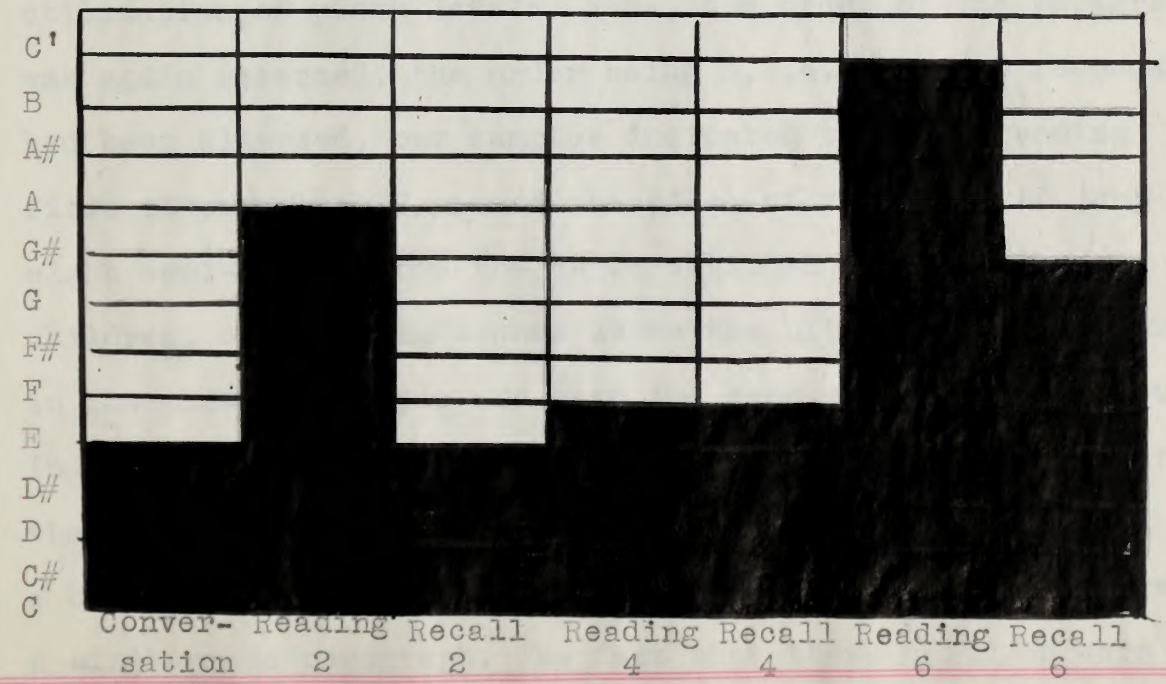
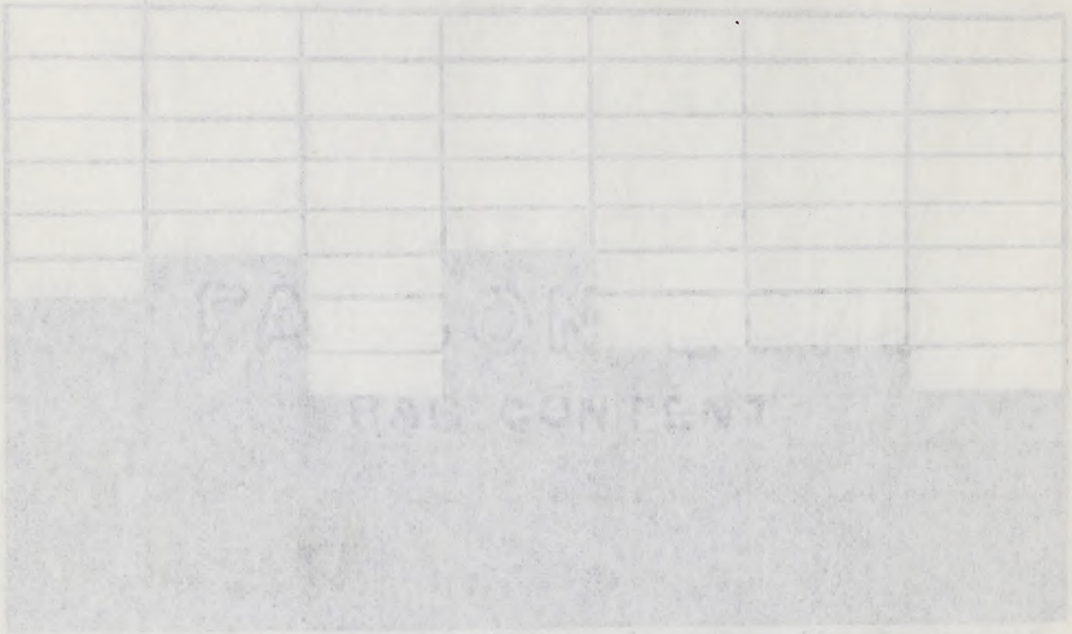
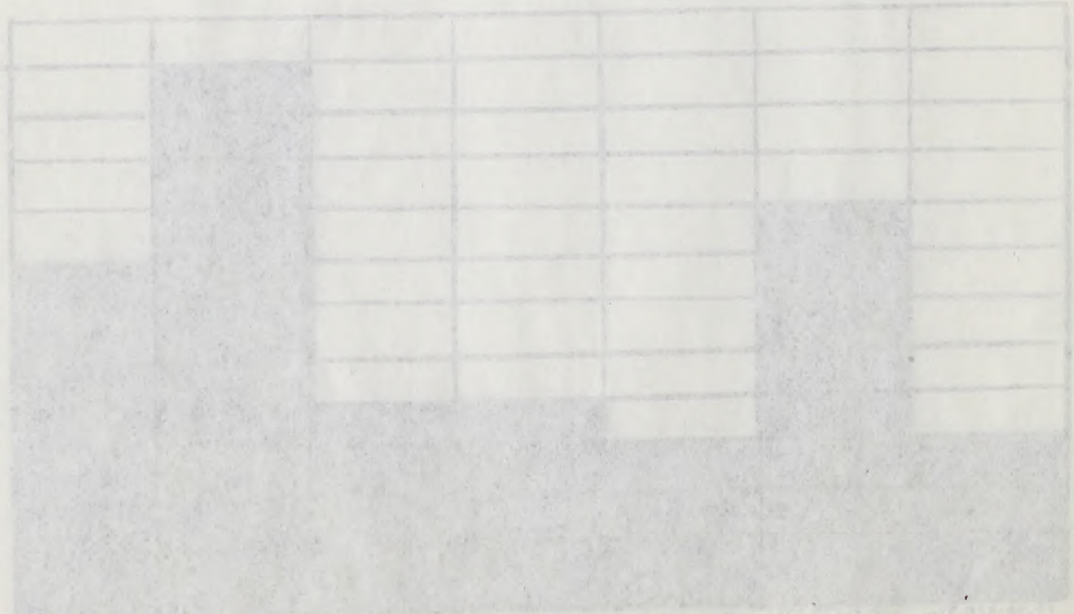


Figure IV

Average Pitch Levels of 8 Fourth Grade Pupils in Conversation and Oral Reading of Paragraphs 6,2,4 of the "Durrell Analysis of Reading Difficulty" (in order named)







more difficult passage. A consultation with the home room teacher disclosed this after the conclusion of the experiment, and since the grade levels of the paragraphs were not men - tioned to the children - except in the case of 6 - little can be done about it except to offer this as an explanation.

The author, however, feels that this "smoothed" profile for the group is significant in that it raises the question as to what extent the expected difficulty or simplicity of reading material is reflected through pitch. The answer can not here be given, but it is indicated that it may be an important condideration in the analysis of data.

Because there were but eight children represented in the next figure (Figure IV, page 48) no definite statements can be made on this profile, which is the most interesting obtained from this investigation, in that it points directly to the fact that habit plays a very important part in the utilization of pitch levels. Here, the order of the paragraphs was again reversed, the order being 6,2,4. When our records had been alayysed, our samples indicated that the reading first of paragraph 6 caused the pitch of the voice to jump eight semi-tones above the conversational level of these children, or four semi-tones above the pitch used by the children in the previous sample who read the same paragraphs, although in different order. This is not a chance increase, nor were these children any less bright than the others, indicating a biased comparison. These children knew they were first reading a sixth-grade paragraph. The fact that these children were

2 in his natural conversational tone, his reading for this paragraph on this grade level increased in pitch but one semi-tone, an increase which remained constant for the recall, as well. This is another instance which supports the habit theory, mentioned before. After once the child had assumed his natural pitch level, his reading did not increase but slightly for that material of which he was capable of complete mastery.

Figures V and VI, page 52, may here be discussed together, since they present the pitch levels of children scoring above and below grade 4-7 on the "Metropolitan Test". The profile is presented irrespective of the order of the paragraphs read, but not-with-standing, indicates a significant difference to the effect that poor readers use a relatively higher pitch throughout all reading than do better readers, the pitch growing progressively higher as the difficulty of the material increases, The less capable readers show a three semi-tone increase over their conversational level in Reading 2, to an 8 semi-tone increase in Reading 6, as compared with the better readers who show a pitch increase of two semi-tones over their conversation for Reading 2 to but three semi-tones for Paragraph 6.

Figures VII and VIII indicate the levels of boys as contrasted with girls - this, as in the previous figures, not taking into consideration the order of the paragraphs, nor the scores on the "Metropolitan Test". The boys show little difference (less one semi-tone) from the girls in conversation.

Figure V

Pitch Profiles of 16 Readers Scoring Above Grade 4-7 on the "Metropolitan Achievement Test" (profile irrespective of the order of the paragraphs)

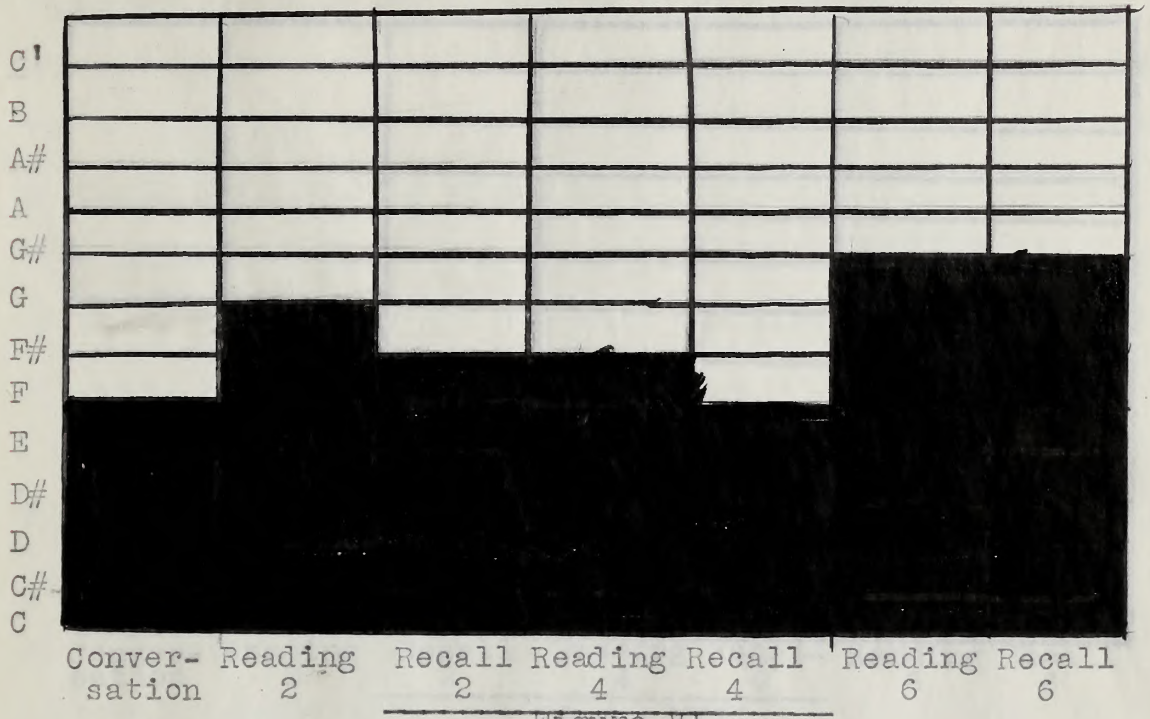
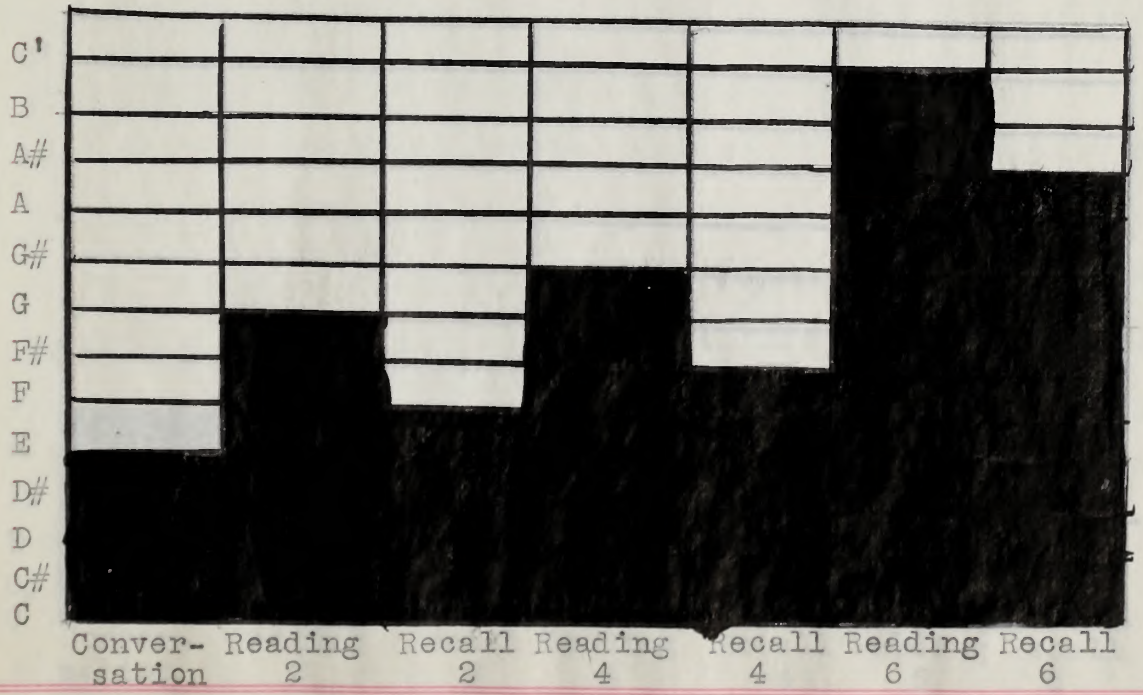
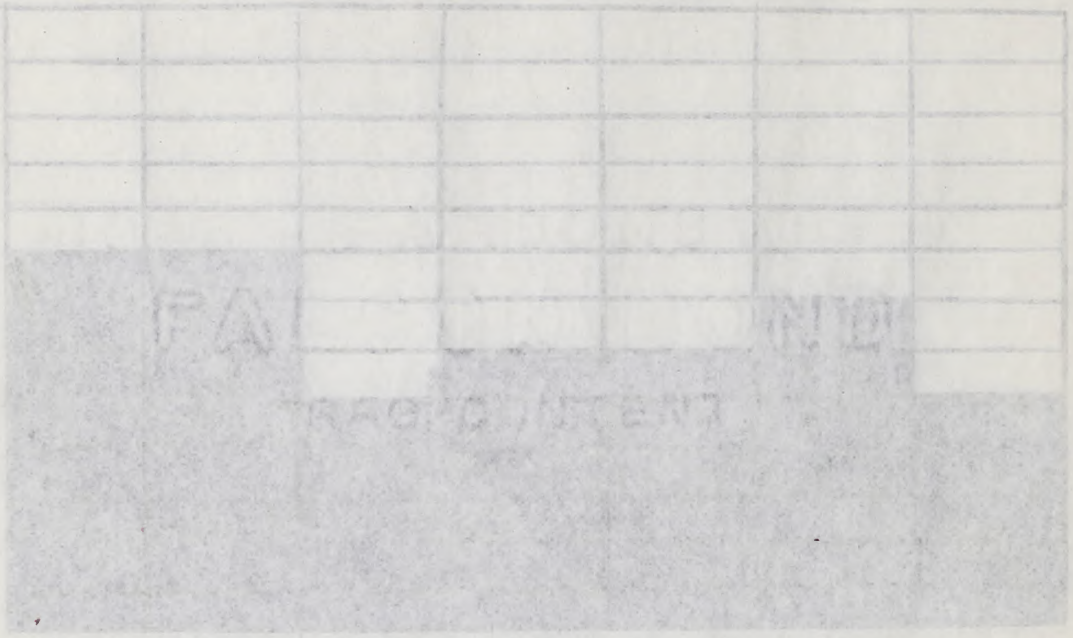


Figure VI

Pitch Profiles of 13 Readers Scoring Below Grade 4-7 on the "Metropolitan Achievement Test" (profile irrespective of the order of the paragraphs)





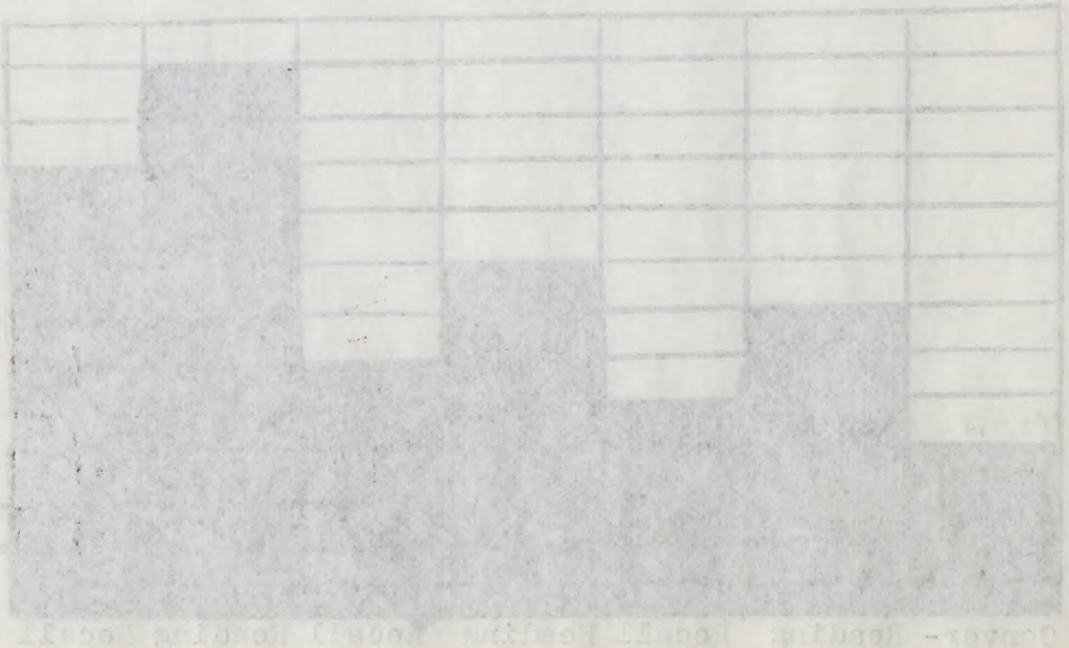


Figure VII

Pitch Profile of 13 Boys Reading Paragraphs # 2, 4, 6 of the "Durrell Analysis of Reading Difficulty" (profile irrespective of the order of the paragraphs)

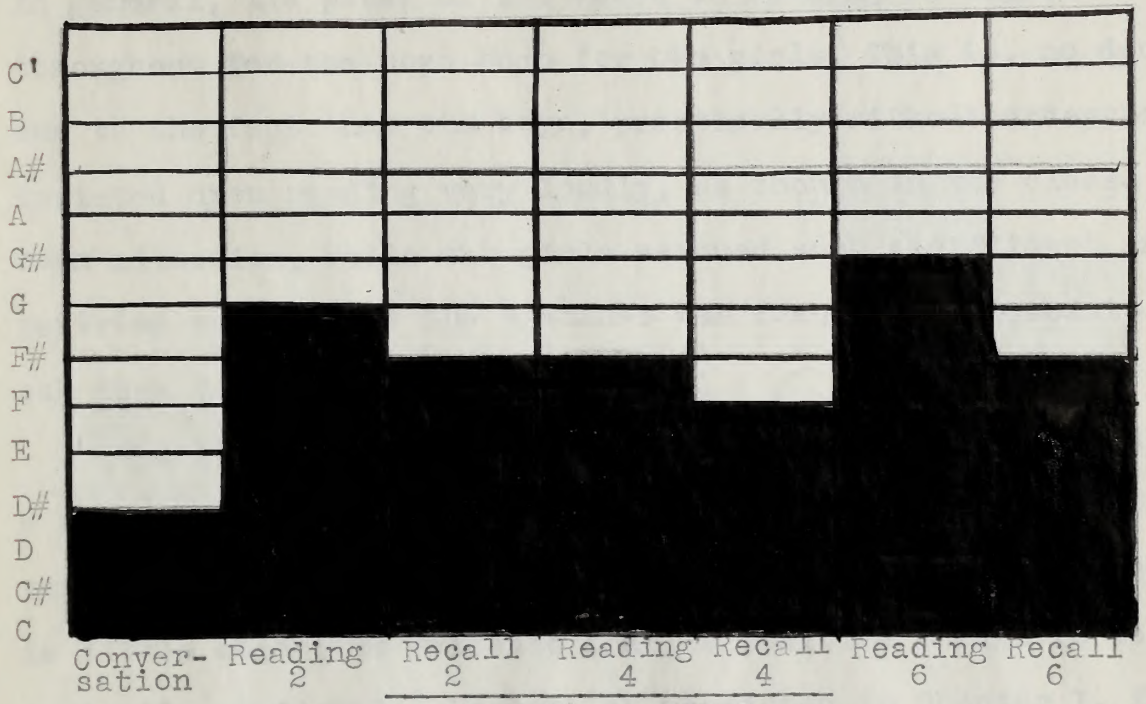
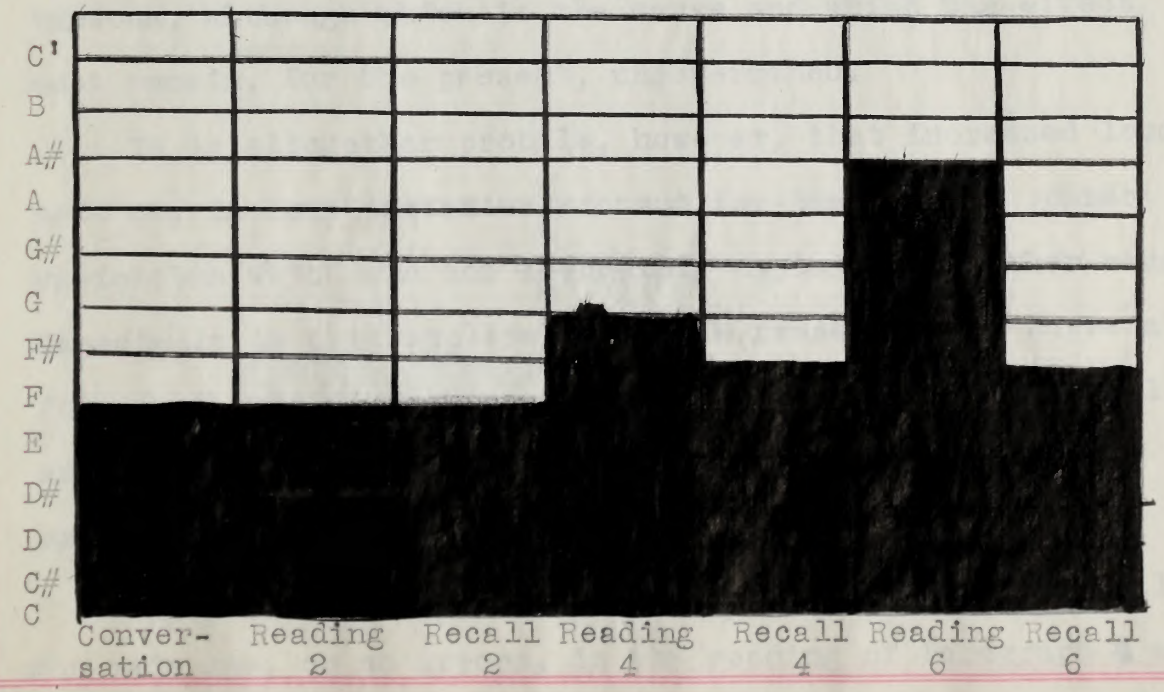
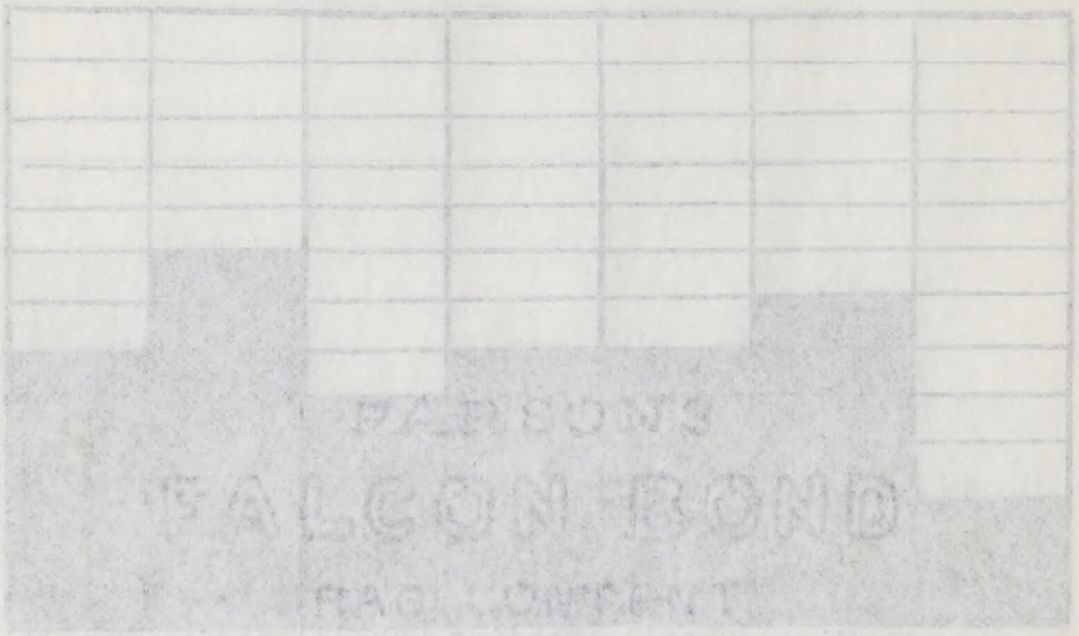
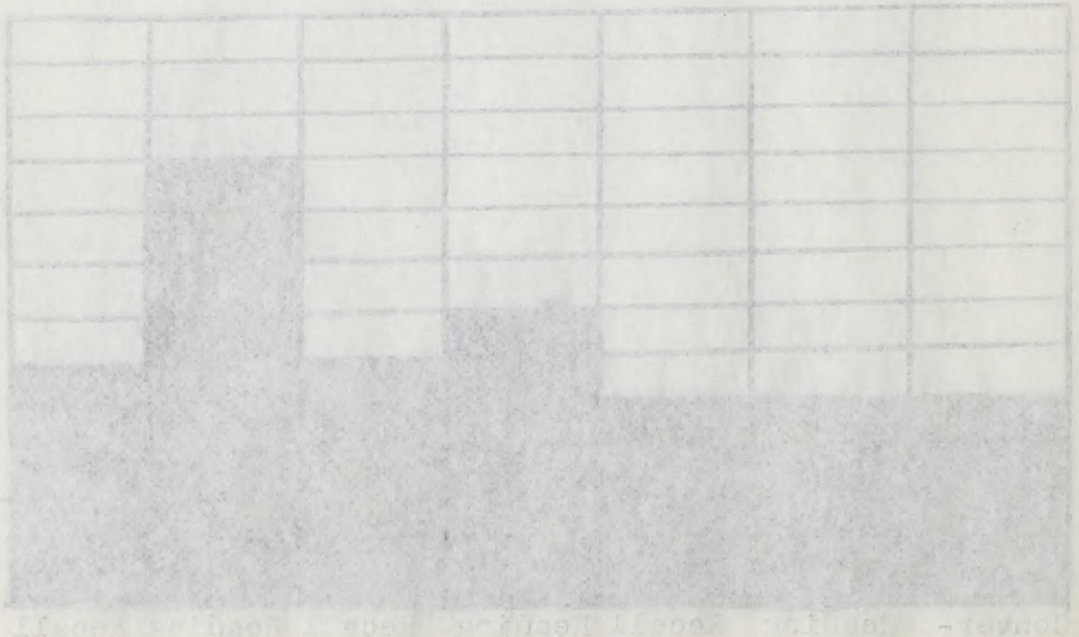


Figure VIII

Pitch Profile of 16 Girls Reading Paragraphs #2, 4, 6 of the "Durrell Analysis of Reading Difficulty" (profile irrespective of the order of paragraphs)




PARSONS
FALCON BOND



This is to be expected, since great differences in pitch between boys and girls voices are not readily apparent until pubescence. In general, the pitch of the voice in reading is higher throughout for the boys than for the girls. This is, no doubt, due to the fact that the boys, practically without exception, insisted upon reading very loudly, as though in the class-room situation, while the girls assumed such a diffident and retiring manner that the examiner was frequently forced to ask them to speak more loudly.

The effect of loudness on the pitch of the voice, and as a contributing cause of many of many of the unexplained pitch variations has not here been discussed, largely because there is little objective evidence that is positive enough to be generally applicable. Horton, as mentioned in Chapter I, found that when an actor shifted from conversational to audience speech, heightened pitch and increased loudness were simultaneous, although which is the cause and which the effect must remain, for the present, undetermined.

It is altogether probale, however, that increased loudness may in many instances account for the unusual pitch variations which are not adequately explained by other causes. Especially is this applicable to the present data, where a four semi-tone difference between the conversational level and simple reading level of the boys and the girls is explained by no other factors.

Figures IX and X present the profiles for those pupils who made one, or no errors, in the reading of Paragraph 4 and

Figure IX

Pitch Profiles of 15 Children Who Made No Errors, Or One Error in Reading Paragraph # 4 of the "Durrell Analysis of Reading Difficulty"

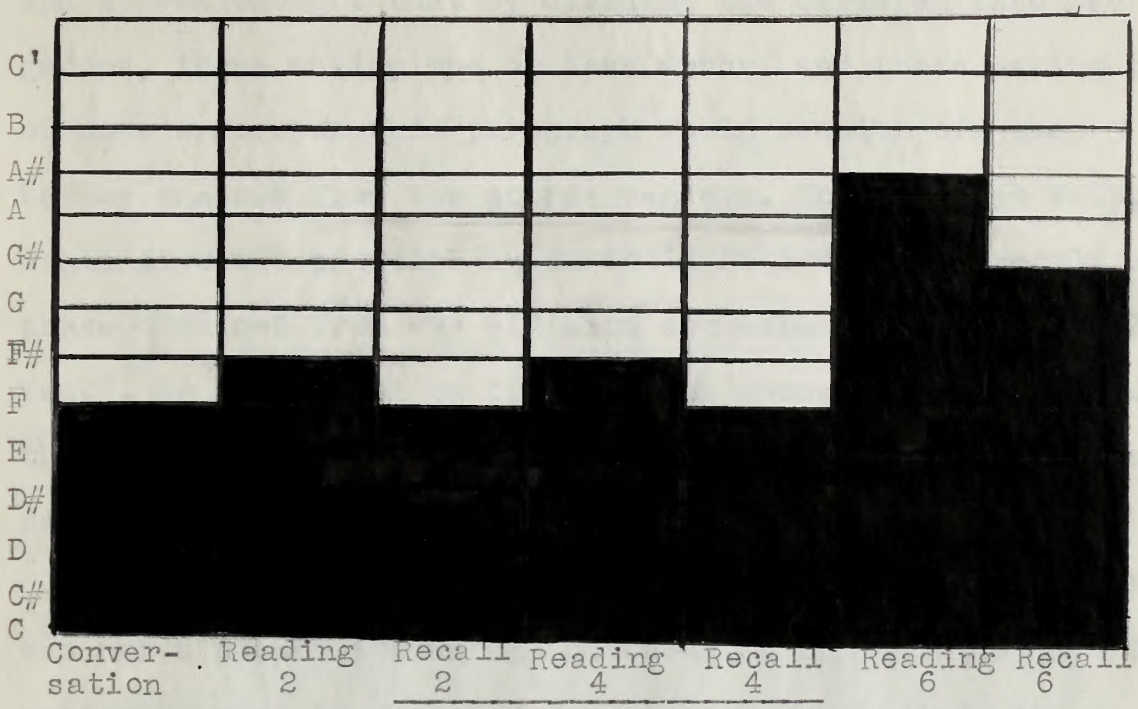
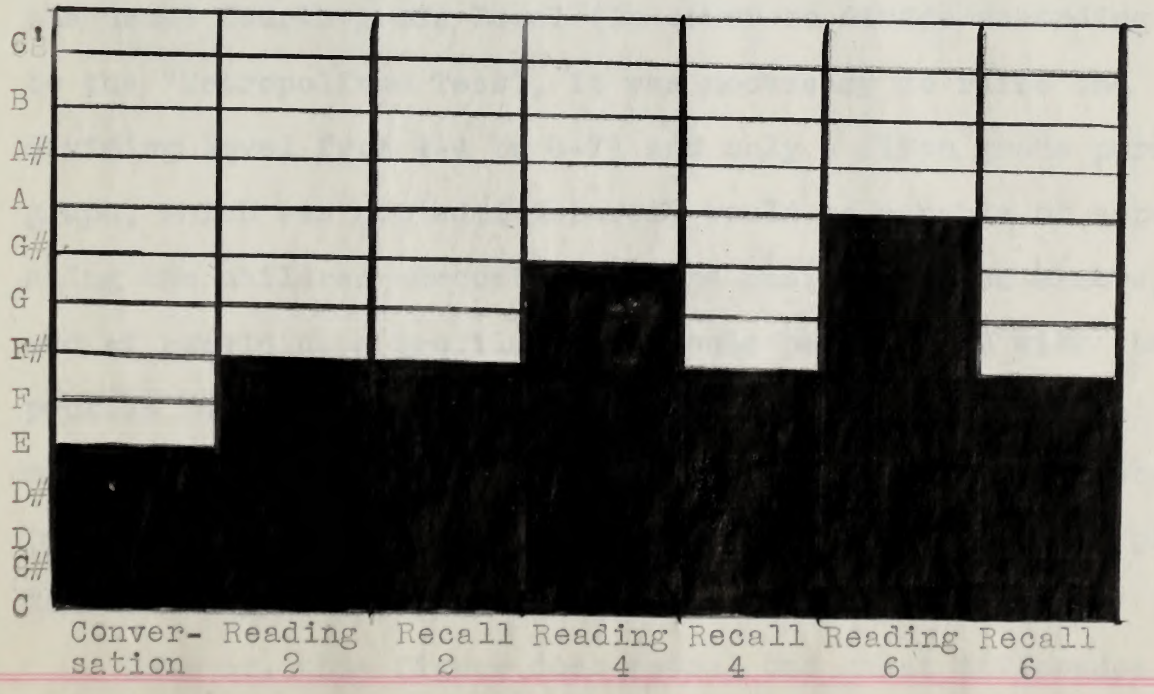
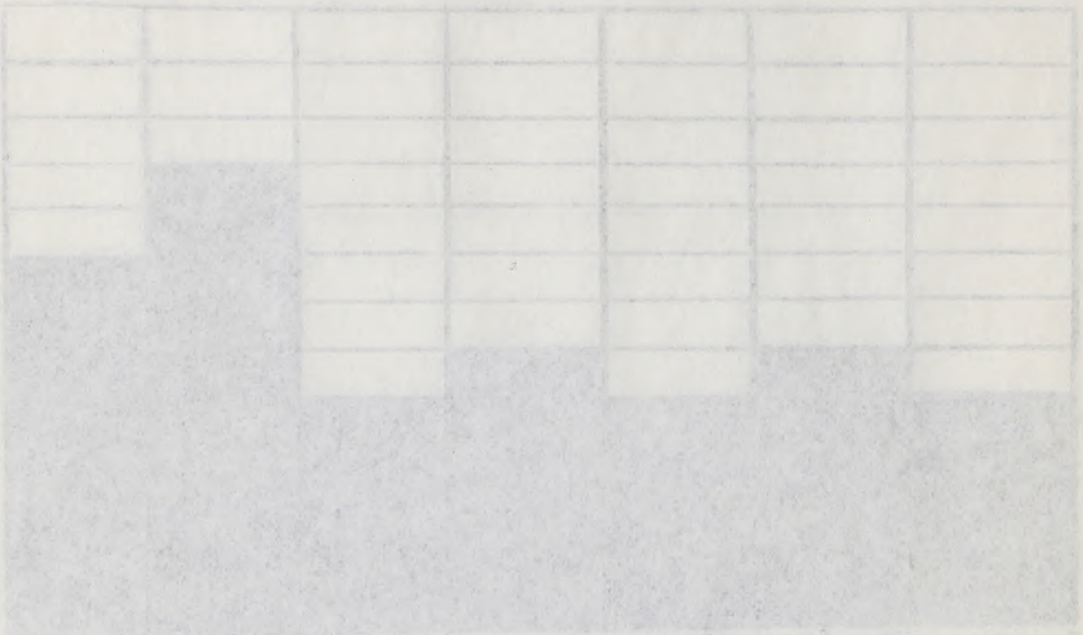
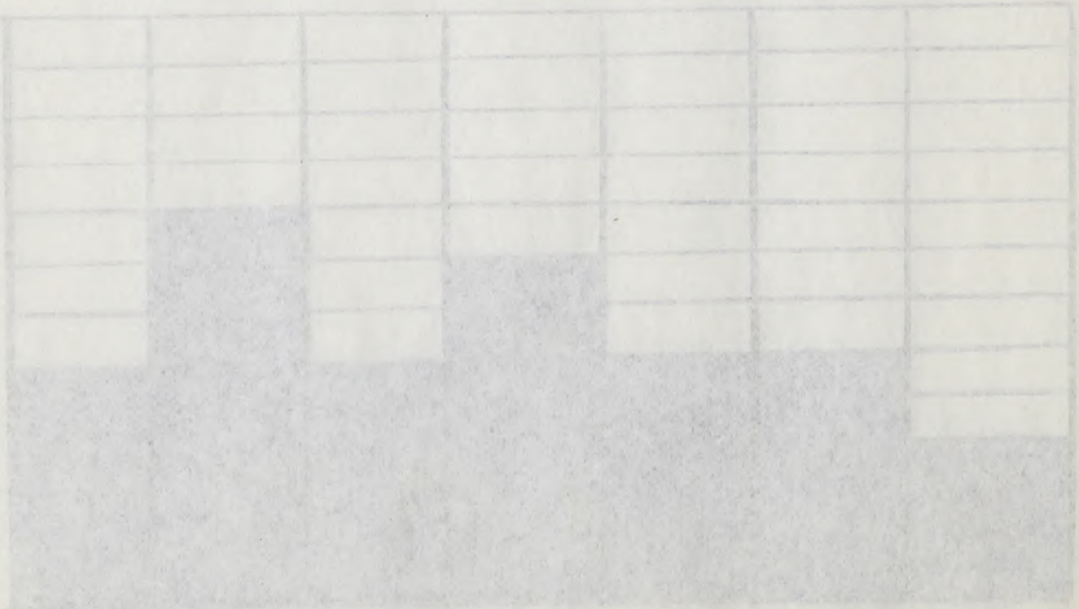


Figure X

Pitch Profiles of 11 Children Who Made Three or More Errors in Reading Paragraph #4 of the "Durrell Analysis of Reading Difficulty"







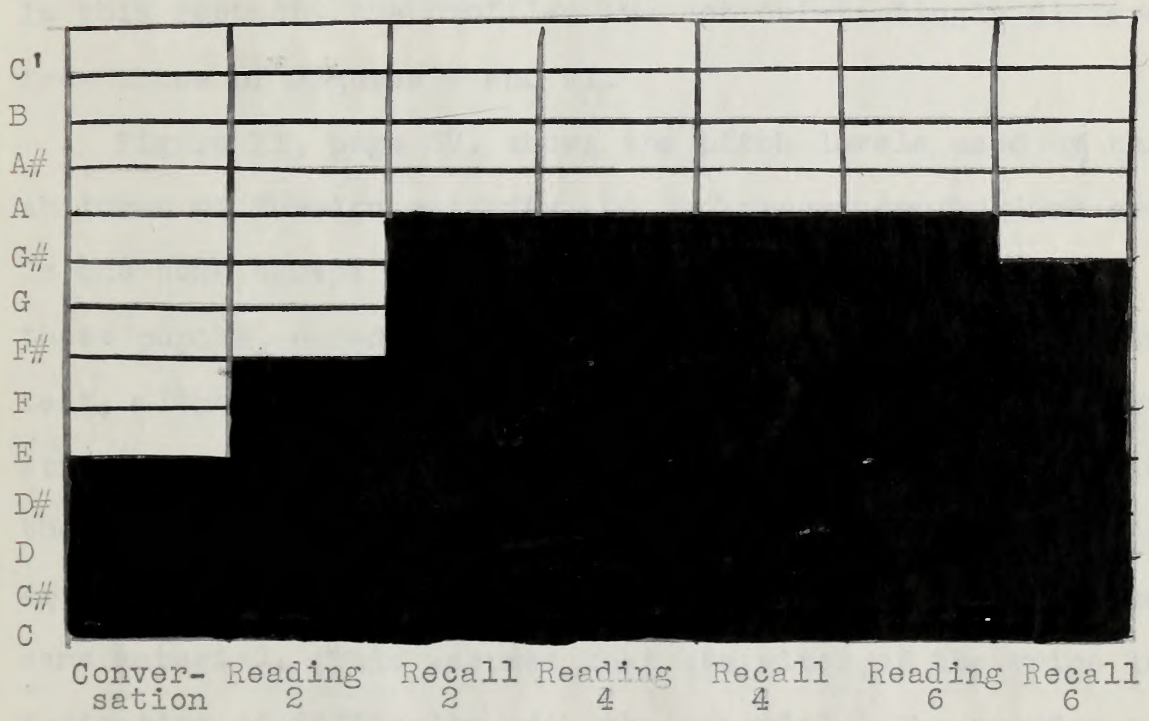
the profiles of those pupils making three or more such errors. The median number of errors for Paragraph 4 was two per child, and it was thought that by dividing the children into two groups, those making one or less error, and those making three or more errors on this paragraph would section off the better readers from the poorer readers. This, it was felt, would give two profiles which could be compared directly with those obtained from the division suggested by the"Metropolitan Test". An inspection of the profiles shows that this is not the case, for, in this illustration, our"poorer" readers are not strikingly different from the "better".

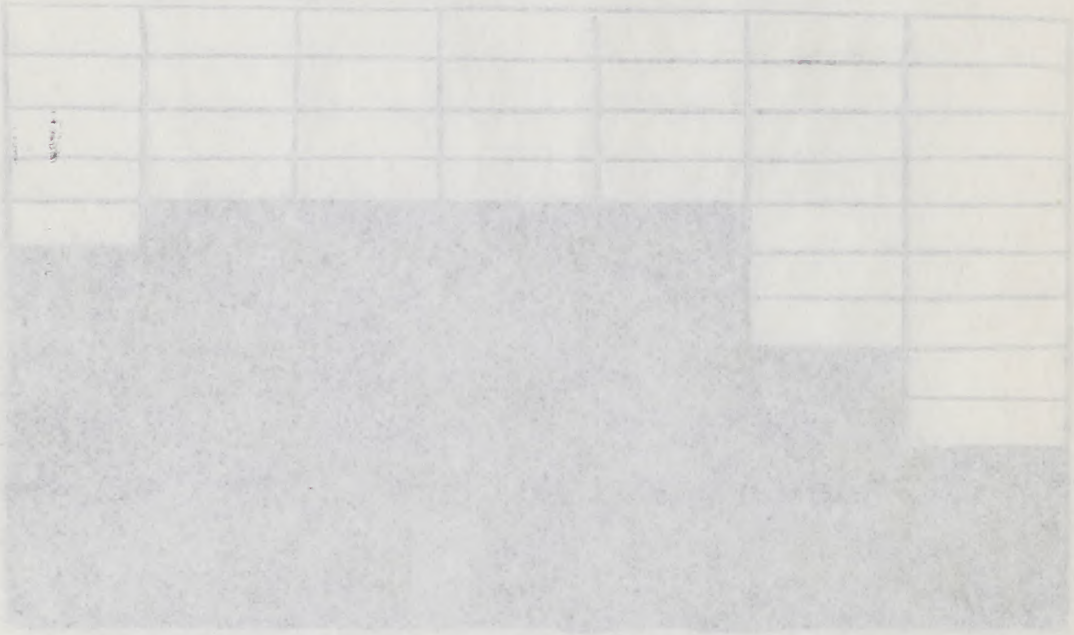
This is so largely because three errors on the paragraph was not a senstitive enough criteria. A child fails on this paragraph when he scores seven errors. Thus, since our division was arbitrary, we have not truly segregated the groups according to ability. In addition, the class is above the usual fourth grade level (in order to divide according to the "Metropolitan Test", it was necessary to raise the dividing level from 4-4 to 4-7) and only a fifth grade paragraph, which was not administered, would be capable of separating the children adequately on the basis of seven errors, and of providing a profile which could be compared with the profile for the "Metropolitan Test". Secondle, there is a much larger number of children in Figure IX than in X, hence, by force of numbers, the probability of obtaining higher pitch levels for this group is greater.

However, this figure does reveal one great difference

Figure XI

Showing The Pitch Profile of Three Fourth Grade Children of Foreign Nativity and Background





between the groups, and that is in the matter of pitch for the easier reading and recall. The pitch of the "better" readers rises and falls one semi-tone rather regularly, following in pattern the averaged profiles for the entire group,(Figure I) while throughout the selections for the"poorer" readers, the pitch increases regularly with the difficulty of the material. In this respect, the profiles are not outstandingly different from those of Figures V and VI.

Figure XI, page 57, shows the pitch levels used by three children of foreign nativity and background (no English spoken in the home except by children of school age). Each of these pupils scored in the lowest profile of the achievement test, although they appear bright enough socially. The most striking indication from this figure is that which signifies that the recall of the subject matter for these children is equally as difficult as, or harder then, the reading of the same material. (This assumes that the pitch of the voice is indicative of difficulty with the material.) The reading and recall for these children was largely in a word-by-word manner, a halting for ideas in the recall, a stumbling, strained manner in the reading, During the reading of Paragraph 4, the voice had assumed a steady, monotonous pitch, and there remained until the recall of Paragraph 6, where a semi-tone drop in pitch occurred.

The last table (Table IV) indicates the average, lowest, and highest pitches, as well as the range, used by these

Table IV

Showing the Lowest, Highest and Average Pitches Employed by 29 Fourth Grade Children in Conversation and in the Oral Reading of Three Paragraphs of the "Durrell Analysis of Reading Difficulty"

	Lowest	Average	Highest	Range (in semi-tones)
Conversation	G#.	E	F'	21
Reading 2	A.	F#	E'	19
Recall 2	G#.	E	C'	16
Reading 4	F.	F#	D#'	22
Recall 4	A.	E	D'	17
Reading 6	B.	A	G'	20
Recall 6	G#.	G	D'	16

children under discussion. This table does not present the frequency of the pitches, although the pitch here cited was reported by all observers. (One exception to this is in Reading 4, where two observers report F., and the third reports A#. .) This table is hardly significant, but it included to show that the range of the childrens voices varied from the lower limits of the average alto voice to within four semi-tones of the upper limits of the average soprano voice, a large range fro such a limited investigation.

A summarization of the data included in this section is presented in Chapter IV, but a few observations on the analysis of data may here be presented.

In the pooling of data to obtain average profiles, we lose sight entirely of the individual child. This should not be so, since pitch is a completely individual function, and by nature not meant for generalizations and averagings. However, were one to discuss, and present illustrations for individual children only, the difficulties of explanation and interpretation would be completely overwhelming, even for a group this size. Averaging the data was the only feasible way in this study to present indications and trends.

Explanations of pitch phenomena must take into consideration such a multitude of variables, educational, psychological, social and emotional, as well as the chance factor, that the explanations herein offered, even for the average groups, must be viewed as possible interpretations, not ultimate solutions.

There can be no single cause of pitch variations, but several causes may, in the light of supporting evidence, indicate possible factors whose combined efforts produce a single effect. To make strong conclusions from such data, obtained in such a relatively short interval, is completely rash.

In addition, no average group contains the same number of children in the averagings. This is unfortunate, since direct comparison between groups is made impossible, but little can be done now that the data has all been obtained.

In the selection of typical passages it will be noticed that the samples often contain a wide variation in pitch range, for example, the reading of Paragraph 6 by Child 1B shows a fluctuation from C to C' and back to G#. . Questions might well be raised concerning the selection of such a passage as representative. However, if wide ranges were employed throughout the passage, the sample selected also contained a wide range, in addition to the centering of the pitch about a certain level which is the dominant pitch for the obtained passage.

This is here mentioned in order that the significance of a four or five semi-tone increase from one level to another may be better understood. "Significance" and "significant" were terms often loosely employed in this Chapter, especially in reference to an increase similar to the one mentioned above. How significant these changes are, in the statistical sense of the word, is undetermined. We know from Cowan's

study that the average pitch level of a given individual in different dramatic passages having the same pitch level can vary as much as five semi-tones, and still be an accurate interpretation. Strictly speaking, this study should have reserved the use of "significant" to designate only those pitch increases above this five semi-tone variation, but this procedure seems a little unecessary in that these subjects are children, untutored in the dramatic techniques, reading three paragraphs of factual material in a more or less natural situation. It may then be assumed that if different samples of the child's reading - each sample equally as representative of the range employed in the entire selection - vary their average pitch By four or five semi-tones, that increase is significant.

Exactly what this significant difference in pitch levels betokens has usually been understood to be either increased difficulty of the reading, or of a tension arising from within the situation that is not a result of innate difficulty of the material. With an understanding of the procedure used in the selection of samples, the use of"significant" to describe these varying average pitches will not be questioned too severely.

A further liberty has been taken in assuming that high pitch is indicative of tension, and that tension is indicative of some reading difficulty in the situation. We know definitely nothing of the sort, and the only basis for such an assumption is that other wrotes have also assumed the same thing.

Whether this is true or not, as must be proven by research, it has, in this study, been understood as true, and many of the conclusions have for a cornerstone only this slender opinion,

With the above criteria of significance in mind, we may proceed to the "Summary and Conclusions", Chapter IV.

SUMMARY AND CONCLUSIONS

Summary and Conclusions

Summary

To obtain the data for this investigation, twenty-nine fourth grade children read three paragraphs from the "Durrell Analysis of Reading Difficulty", one paragraph designed to test second grade reading, one for fourth, and one for sixth. In addition to the checking of errors for the reading of each parahraph, the conversation of two of the children alone in the room, and selected sentences from the reading and recall of the material was permanently recorded on records. Thus was obtained samples of the conversation and the reading and recall of three paragraphs for each child in the investigation.

Three judges scoring high on the "Seashore Test of Musical Talent" were asked to judge the pitch of five running syllables of speech from each of these levels, for each child. This made a total of one thousand fifteen syllables analysed by the judges. To check on the reliability of these judgments, each judge re-evaluated ninety syllables of speech, from which correlation coefficients were obtained for the agreement between jugdes and judgments.

From these judgments thus evaluated, data was secured on the following: the average pitch levels of the twenty-nine subjects for conversation and for the each level of the reading and recall; the pitch levels employed by boys and girls; the pitch levels utilized by better and poorer readers, and the readers from foreign language backgrounds.

These data, in general. agree upon a few main points, namely: that heightened pitch accompanies difficult reading, or the initial reading above the child's fluent reading level. Once a pitch was raised abnormally for the reading material, the indications are that it there remains for some times, until the child has either been assured that less difficult reading is to follow, or has once regained his usual pitch level through recall of the material.

Little difference in the pitch profile of boys as contrasted with the pitch profiles of the girls is evident, except that the loudness of the boys speaking voices caused the pitch to remain a little higher throughout the reading. The range of pitch is no greater for the boys than for the girls, if we count the number of semi-tones from the conversation to the highest pitch level.

A marked difference in the pitch levels employed by better and poorer readers is apparent, the better readers employing much lower pitches throughout all reading, although slightly higher pitches in the conversation.

Bilingual children are considerably handicapped in their reading, as much by their inability to either understand the material or to recall the ideas fluently, as by the mechanics of the reading itself.

Data on the reliability of observers' judgments indicate that the correlation between judges and judgments vary markedly, from very low to very high. A fair degree of

correlation, in consideration of the many difficulties attendant upon obtaining such a correlation, is usually present.

Conclusions

In view of the limited number of subjects used in this investigation, and of the low correlations obtained on the three judges, no sweeping conclusions or great generalizations can be made from this data. Thus, many qualifications and limitations of the conclusions to but conclusions for this study only, must be expressed. This is here mentioned, and when necessary, is stated again in the following paragraphs.

The conclusions for this study are:

(1) Difficult reading is reflected by heightened pitch of the voice in oral reading, though heightened pitch is not always indicative od difficult reading material. A constant raising of the pitch for each increasingly difficult selection was present in each child in the investigation. Although there are, conceivably, many factors which would account for the raising of the pitch in some instances, these other factors as sole explanations for all pitch increases are completely inadequate. The one influence that was constant throughout, and thus may account for the heightening of the pitch, is that of the difficulty of the material.

(2) Most oral reading utilizes a pitch level above that of conversation. The few exceptions to this are those instances in which the recorded conversation was completely spontaneous,

and as a result, loud. The effect of loudness on pitch has been summarily discusses, and in some instances this may account for a higher pitch in conversation than in reading, although it is equally probable that many children, and the majority of adults speak no louder in their reading than in their conversation, the pitch in both instances being entirely relative to the situation and not to habit.

(3) The pitch of the voice remains high even when the original stimulus of reading difficulty and/or tension has been removed. This study observed a strong trend for the pitch of these childrens' voices to remain almost as high for the reading of a simple paragraph (after reading difficult material) as for the reading of the difficult material itself. Although no conclusions as to habit patterns can be made, we find that the continuance of a situation in which the pitch is raised may result in a continuance of the pitch when the situation has been removed.

(4) The pitch of the speaking voice may be evaluated by judges if but an average, and not an exacting, picture,is desired. The reliability of pitch analysis by the subjective method of matching the pitch to a piano is not, in this study, as high as the literature in the field reports. This indicates in itself, that the judgment method requires such a nice selection of judges, records, acoustical properties of the room, and other such physical conditions, that it is little easier, and far less accurate than analysis by mechanical

methods. When, for financial reasons, this method is necessary, extreme caution in the analysis must be evident.

In summary, high pitch of the voice in the reading situation may be caused by (1) difficulty of the material, (2) tenseness of the situation, and (3) habit, induced by the continued oral reading of difficult material.

LIMITATIONS OF THE PRESENT INVESTIGATION

Limitations of the Present Investigation

Many limitations of this investigation have been mentioned throughout the study, but may here be recapitulated for further emphasis. The principal flaw in this investigation is in the limited number of subjects used. The conclusion obtained from but twenty-nine children are of use only in the nature of pointing out trends or indications, for generalizations on all reading they are highly gratuitous.

In addition, the data - although pains were taken to insure its reliability - may, in many instances, be completely biased. This does not mean deliberate bias by the author, but the inevitable bias that occurs in the selection of representative passages from but very small original samples. Also, the samples were obtained from a testing situation, and must be viewed as such. Any reading that a child performs before a critical adult must, in the last analysis, resolve into a testing situation, this despite any ammount of rapport. These data must be likened to the data secured from an individual intelligence test - that obtained from a child in a testing situation and to be compared with those obtained from other children under identical physical circumstances. Had the recording device been successfully concealed in the classroom, and had no adults except the teacher been present, the records might be considered more authentic.

A further limitation is that these children are reading but one type of material - narrative, strongly factual.

Dramatic passages, even poetic passages, might reveal a quite dissimilar pitch profile for the group, with individual differences, and not the profiles, assuming the chief role in the report.

The obtained records themselves, are far from flawless. Electrical interference, whose source could not be traced, occasionally blurred many passages, this imposing a greater handicap on the judges. Then too, the acoustical properties of the testing room and the room used for analysis were not taken into consideration, This resulted in a "hollow" background in the records, and an echo effect when played to the judges.

In general, the investigation reveals many limitations, no one of which completely invalidates the data, but the several combinations of which may result in a report whose flaws must be considered as carefully as the data it presents.

INDICATIONS FOR FURTHER RESEARCH

Indications for Further Research

Before a complete understanding of the pitch factor in reading can be obtained, there remains much research to be first accomplished.

Such an understanding would first call for the penetrating analysis of the pitches commonly used in American speech. With this as a base, the relationship between pitch and muscular tension must be thoroughly investigated. This is a fascinating problem, and a highly significant one for the speech field. Such an investigation would require the elaborate laboratory devices used to measure the changes in bodily tones and energy, in addition to the recording of voices speaking different types of material, and the analysis of these data by phonophotographic instruments. How these measurements can best be obtained in a situation relatively free from the laboratory and laboratory impedimentia is no small part of the problem. If keen judgment be used in the selection of subjects, this study should explain many of the pitch phenomena that in our present state of knowledge remains open to but speculation.

Studies on the variability of average pitch must be performed to determine how much the conversational tone varies from day to day, or perhaps from hour to hour. This study should further discuss within what limits the pitch of the voice may vary - while reading the same material - and yet remain within the normal pitch range.

With the above as background, the present study should

be duplicated, for the explanations of many of the pitch variations observed in the childrens reading may then be explained with authority, and hence the educational implications of heightened pitch may become apparent.

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APPENDIX

TABLE A

Showing the Sex, Age, and the Score on the "Metropolitan Achievement Test" of the Group Used in this Investigation.

Child #	Sex	Age	Score
1A	F	9-0	4-9
1B	M	9-9	5-1
2A	M	8-11	5-3
3A	F	9-10	4-8
4A	F	10-1	5-0
4B	F	9-10	4-7
5A	M	9-9	4-6
5B	M	9-10	5-2
6A	F	10-5	4-8
6B	M	10-3	5-0
7A	M	9-2	4-7
7B	M	8-9	5-6
8A	F	9-9	4-4
8B	F	9-8	4-1
9A	M	10-0	3-7
9B	M	9-10	3-0
½ 10A	M	10-2	3-8
10B	M	10-11	4-6
11A	F	10-2	3-8
11B	F	9-11	4-8
12A	M	9-9	5-3
12B	M	9-10	4-9
13A	F	9-2	4-6
13B	F	10-3	5-2
14A	F	11-5	4-0
15A	F	9-5	5-4
15B	F	10-1	3-8
15C	F	9-3	4-0
Totals or Averages 29	13M 16F	9-10	4-7

The three paragraphs used in obtaining data were taken from the "Durrell Analysis of Reading Difficulty", and are included below. The underlined sentences indicate those recorded.

2. The Cat and The Dog

A boy had a big gray cat. He was going to give her some milk. She did not come when he called. He saw her up in a tree looking down at a big dog. The boy sent the dog away. Then the cat jumped down and came for her milk.

4. The Accident

A boy was hurt on our street yesterday. He had been playing ball and was riding his bicycle away from the ball field when a car came down the road. He did not see the car coming because he was looking back at the boys who were still playing baseball. The car was going slowly. It hit the boy, but did not run over him. His arm was hurt and his bicycle was bent.

6. Uses of Kites

Large kites have been used for a great many things. In war they have been used to carry signal lanterns and to carry automatic cameras over enemy territory. One general used kites to pull ropes over a swift river so that he could start to build a swinging bridge. Some people in China make "singing kites" which are supposed to frighten away evil spirits. The weather bureau has used kites to study temperature and the speed of the wind at great heights. A string of kites once went up over four miles in the air. Some kites are big enough to lift a man.

Criteria Used in the Scoring of Reading Errors

Since a large discrepency exists between the reading errors reported in this investigation and those reported by two other investigators, (page 32) it was thought advisable to include the criteria this author followed in judging a reading error. The criteria are as follows:

(1) Word-by-word reading, occasional phrase reading and inadequate phrase reading were understood all to be the same error, differing in degree. Word-by-word reading was scored when the child read three or more phrases in a word-by-word manner. The halting that accompanies the appearance of an unfamiliar word in the sentence is thus, not scored. If the error persists, the word-by-word reading becomes occasional phrase reading. In addition to this, when the phrases are read unintelligently, destroying thought units, the author scored inadequate phrase reading. The last error indicates that both of the former are present.

(2) The voice, ennunciation and expression errors cannot be followed in any such rigid manner. Sufficient to say that a "strained, high-pitched voice" can only be scored if the child's voice is in his highest register, not if the voice appears higher in relation to the others in his reading group. A high-pitch voice, which may sound strained, is the customary voice for some types of children, and this high-pitched voice may have its own higher and lower tones. If, through conversation we first discover the child's unusual pitch level

the error only when his reading utilizes pitches above this prevailing tone of delivery.

(3) Monotonous tone and inadequate expression were taken to mean distinct comments. Monotonous tone in this study has distinct reference to the rythm and pitch of the voice. Monotonous tone indicates a lack of expression, but may not be scored in place of it. Inadequate expression was not scored until after the child had given the recall of the material. If the recall was adequate, yet the reading conveyed the impression that the child did not comprehend the padsage while reading, the error was checked. If, on the other hand, the recall bore out the original impression that the child did not understand the reading material, the error checked was poor comprehension, or inadequate recall.

(4) The ennunciation errors depend largely upon the examiner's own ear and speech habits, interpreted with a knowledge of the standards of speech set by the educated leaders in the community. Since, in this study, a picture of the general speech habits was wanted, the errors included under ennunciation were largely errors of elisions and assimilations, mumbled speech and speech sound substitutions (if they occured infrequently enough to be classified as an error and not a defect.

(5) Ignoring of punctuation and the habitual repition of words are both comments that contain specific determinants of frequency, and hence, could only be checked once if the error

occurs more than once. In this study, however, the errors were assumed to mean "How many times does the child ignore punctuation?" and "How often does he repeat words?" Thus, any repitition of words or disregard of punctuation was scored. This, of course, accounts for one great difference in t the total number of errors reported in this investigation.

(6) "Sight vocabulary too small" was not checked in reference to the reading of Paragraph 6, since fourth grade children can hardly be expected to master sixth grade reading. In addition, the error was noted only if the child had to be prompted on two or more words.

(7) The greatest percentage of reading errors in this investigation was "errors on smaller words". As in Paragraph 5 (above) any error on any small word was checked. This error was largely in Paragraph 2 when "He saw her up in a tree" was read as "He saw her up in the tree." Although it verges on the triflingto record this as an error, it was done, nevertheless.

(8) Unfortunately, "word insertions and omissions" was not broken down into two separate errors, for when the data had been assembled, it was impossible to determine which error was responsible for the total high percentage reported. As in the two above criteria, any insertion or any omission was checked.

(9) The last error about which there may be doubt is that of "inaccurate guessing on words". If a child sounded

a word out by a phonetic method, yet arrived at an incorret pronunciation (e.g. since an "e" on the end of a word makes a single vowel say its own name, the terminal "e" on "bridge" might result in the pronunciation of "bry-dge") the error was not checked,and the correct pronunciation was given. If, however, the word above was sounded out as "drige" or "bride" or some such combination, the error was scored.

Table B

First and Second Judgments of Each Judge on 90 Selected Syllables

	First Judgments			Second Judgments		
	Judge 1	Judge 2	Judge 3	Judge 1	Judge 2	Judge 3
9B						
	D#	D#	D#	D#	D#	D#
	E	E	E	E	E	E
	D	D	D	D	D	D#
	D#	D#	D#	D	D	D
	D	D	D	D	D	D
	F	F	F	F	F	F
	D#	D#	D#	D#	D#	D#
	D	D	D	D	D	D
	D	D	D	D	D	D
	D	D	D	D#	D#	D
	B.	B.	B.	C	B.	B
	C#	C#	C#	C	B.	C#
	D	D	D	C"	D	D
	C#	C#	C#	B.	C	B.
	D	D	D	C#	D	C
	C#	C#	C#	C	C	C#
	C#	C#	C#	C#	C	C#
	A#	A#	A#	C#	C	A#
	C	C	C	B.	B.	A#.
	A#.	A#.	A#.	C.	C.	B.
	B.	B.	B.	C	C	C#
	A#.	A#.	A#.	A#.	A.	B.
	B.	B.	B.	C	A#.	B.
	B.	B.	B.	C	A#.	B.
	C#	C#	C#	C	C	C
	C	C	C	C	C	C#
	B.	B.	B.	B.	B.	B.
	D	D	D	D	D	C#
	B.	B.	B.	B.	B.	B.
	D	D	D	D	D	E
	A.	A.	A.	A.	A.	A.
	D#	D#	D#	D#	E	D#
	D	D	D	D#	D#	D#
	C#	C#	C#	D#	C	C
	D#	D#	D#	D#	D#	D#
4A						
	G#	G#	G#	A#	C	F
	G#	G#	G#	A#	C	F
	C'	C'	C'	C'	C	C'
	C'	C'	C'	C'	C'	C'
	C'	C'	C'	C'	C'	C'
	D#	D#	D#	D#	D#	D#
	D#	D#	D#	D#	D#	E

Table B (con.)

	First Judgments			Second Judgments		
	Judge 1	Judge 2	Judge 3	Judge 1	Judge 2	Judge 3
	C	C	C	C	C	D
	G	G	F	G	G	G
	C	C	E	C	D#	D
	F#	F#	F#	F#	F#	F#
	F	F	F	F	F	F
	E	E	E	E	D#	E
	C	C	C	C#	C	C
	B.	B.	B.	B.	B.	A#.
	B.	B.	B.	B.	B.	B.
	C	C	C	C	C	C
	C	C	C	C	C	D
	C	C	C	C	C	D
	E	E	E	E	E	E
	D	D	D	D	D	D
	D	D	D	D	C#	C
	E	E	E	D#	D#	D#
	B.	B.	B.	B.	B.	B.
	D	D	D	C#	D	D
	C	C	C	C#	C#	C#
	B.	B.	B.	B.	B.	B.
	D	D	D	D	C#	C#
	C	C	C	C	C	C
	C	C	C	C	C	C#
1B						
	D	D	D	D#	D#	D
	D	D	D	D#	D#	E
	D	D	D	D#	D#	D
	F	F	F	F	F	F
	E	E	E	E	E	E
	D#	D#	D#	D#	D#	D#
	C	C	C	C	C	A
	B.	B.	B.	B.	B.	G
	C	C	C	C	C	G#
	C	C	C	C	C	G#
	B.	B.	B.	B.	B.	B.
	C	C	C	C	C	C
	B.	B.	F	C#	C	C
	C#	C#	D	B.	B.	B.
	C	C	C	C#	C#	C#
	B.	B.	B.	B.	C	B.
	C	C	C	C	C#	C
	F.	F.	A#.	B.	B.	A#.
	D	D	D	C	C	C
	C	C	C	B.	B.	B.
	D#	D#	D#	C	C	B.
	A#	A#	A#	A#.	A#	A#
	D	D	D	C#	C#	C#
	B.	B.	B.	B.	B.	B.
	D	D	D	D	D	D